DEPARTMENT OF THE NAVY
NAVAL WEAPONS STATION EARLE
201 HWY 34 SOUTH
COLTS NECK, NEW JERSEY 07722-5001

IN REPLY REFER TO
5090
Ser 043/145
September 29, 1999

Barry Tornick
New Jersey Section
RCRA Program Branch
United States Environmental Protection Agency – Region II
290 Broadway
New York, New York 10007-1866

Dear Mr. Barry Tornick:

SUBJECT: CLASS 1 PERMIT MODIFICATION FOR THE NEW HAZARDOUS WASTE STORAGE FACILITY, BLDG. C-63, NAVAL WEAPONS STATION EARLE

On September 8, 1999, the New Jersey Department of Environmental Protection issued a Class 1 modification to the Naval Weapons Station (NWS) Earle Hazardous Waste Facility Permit Number 1309A1HP05. The maximum allowable storage capacity at the new hazardous waste storage facility has been reduced from 31,030 gallons to 28,960 gallons. The reduction in permitted capacity was at the request of the Navy.

A storage capacity reduction was necessitated by a reduced containment volume, resulting from a variation of the as-built containment capacity of the building from the original design.

In compliance with 40 C.F.R. 270.42(a)(1)(ii), this notification is being made since you are listed on the "facility mailing list" provided by the State of New Jersey.

If you have any questions regarding this matter, please contact Mr. Gregory Goepfert, Environmental Engineer, at (732) 866-2515.

Sincerely,

A. L. HERMANNI
Safety Director
By direction of
the Commanding Officer

Copy to: New Jersey Dept. of Environmental Protection (Mr. John Scott)

DEPARTMENT OF THE NAVY
NAVAL WEAPONS STATION EARLE
201 HWY 34 SOUTH
COLTS NECK, NEW JERSEY 07722-5001

IN REPLY REFER TO
2B1

5090
Ser 043/024
11 Apr 01

Mr. Anthony Fontana
State of New Jersey Department of Environmental Protection
Bureau of Hazardous Waste and Transfer Facilities
401 East State Street
P. O. Box 414
Trenton, New Jersey 08625

RE: SUBPART X PERMIT APPLICATION FOR OPEN BURNING / OPEN DETONATION OF WASTE PROPELLANTS AND EXPLOSIVES AT NAVAL WEAPONS STATION EARLE, COLTS NECK, MONMOUTH COUNTY, NEW JERSEY, US EPA ID No. NJ0 170 022 172

Dear Mr. Fontana,

Naval Weapons Station Earle submitted a proposal to you on March 9, 2001 to limit lead emissions from small arms and propellant burning operations. The letter indicated that revised pages of our Subpart X permit application, incorporating the lead emissions limitations, would be issued to your Bureau within 30 days.

The permit application revisions are enclosed; three copies are provided for your distribution and use. The revisions are summarized, as follows:

a. In Volume 1, Section B-1c(1) was revised to include new information on lead emissions limitations for treatment at the propellant pans and the small arms pan.

Page Changes: In Volume 1, remove and discard Pages B-2 and B-3 from the current version of the permit application. Replace these pages with the revised Pages B-2 and B-3 enclosed with this letter.

b. In Volume 1, the Executive Summary was revised to acknowledge the new lead emissions limitations for treatment at the propellant pans and the small arms pan and the change in hazard quotients at the Closest Offsite Sensitive and North 18 Boundary receptors.

Page Changes: In Volume 1, remove and discard Page ES-1 from the current version of Section E-2. Replace this page with the revised Page ES-1 enclosed with this letter.

c. In Volume 1, Section E-2-3c(1) was revised to include new information on lead emissions limitations for treatment at the propellant pans and the small arms pan. Tables E-2-15, E-2-16, E-2-18, E-2-19, E-2-27 and E-2-28 were revised to reflect the maximum treatment limit of lead in the propellant pans and the small arms pan, as well as the recalculation of air concentrations and hazard quotients. The insertion of additional text in Section E-2-3c(1) changed the pagination of Section E-2 from Page E-2-4, and following. As a result, Pages E-2-4 through E-2-60 of Section E-2 were re-issued as change pages.

SUMMARY OF CHANGES
NWS EARLE RCRA SUBPART X PERMIT APPLICATION

1. In Volume I, Section B-1c(1) was revised to include new information on the limitations of lead treatment at the propellant pans and the small arms pan.
2. In Volume I, the Executive Summary was revised to acknowledge the new limitation of lead treatment at the propellant pans and the small arms pan and the change in hazard quotients at the Closest Offsite Sensitive and North 18 Boundary receptors.
3. In Volume I, Section E-2-3c(1) was revised to include new information on the limitations of lead treatment at the propellant pans and the small arms pan. Tables E-2-15, E-2-16, E-2-18, E-2-19, E-2-27, and E-2-28 were revised to reflect the maximum treatment limit of lead at the propellant pans and the small arms pan and the recalculation of air concentrations and hazard quotients. The insertion of additional text in Section E-2-3c(1) changed the pagination of Section E-2 from Page E-2-4 on. As a result, Pages E-2-4 through E-2-60 of Section E-2 were re-issued as change pages.
4. In Volume II, the following spreadsheets were revised to reflect the change in maximum lead treatment quantities at the propellant pans and the small arms pan. These changes resulted in revised calculations for lead emissions, lead concentrations, and hazard quotients :

- ADF_2.XLS
- GLCS.XLS
- HQS.XLS
- MASTER.XLS

Review using Draft OB/OD Permitting Guidelines

EPA Region II

RECEIVED
APR 25 2001

A fully trained Explosive Ordnance Disposal (EOD) detachment assigned to the base conducts all OB/OD treatments. The EOD detachment uses the EOD area primarily to treat ammunition, explosives and other dangerous articles stored on base and to conduct EOD proficiency training.

The methods used at WPNSTA Earle to treat reactive materials that have become unstable or obsolete are: OB to for propellants, small arms ammunition, and some explosives by burning, or OD for explosives by detonation.

The EOD area was previously used by state and federal agencies such as the Environmental Protection Agency (EPA), Department of Alcohol, Tobacco and Firearms (ATF), Federal Bureau of Investigation (FBI), New Jersey Department of Environmental Protection (DEP), and state and local law agencies to treat reactive substances obtained off base. The intent is to serve the interest of public safety by lessening the possibility of injuring anyone in the civilian community. Today however, with increasing environmental consciousness, regulations and restrictions placed on the disposal of hazardous waste, the DOD components are prohibited by 10 U.S.C. Section 2692, from using DOD installations for the storage or treatment of non-DOD owned hazardous materials. Only when called upon by federal and civil agencies to provide emergency, temporary storage or treatment of explosives, will non-DOD reactive materials be brought on base for treatment. The OB/OD site is primarily for the use of NWS Earle to treat Department of Defense (DOD)-owned waste military munitions from onsite and offsite and to conduct explosives/ordnance disposal proficiency testing.

B-1c(1) Open Burning (OB)

OB of propellants or explosives is accomplished in a burn pan measuring 4 feet wide, 8 feet long, and 1 foot deep. Burning of small arms ammunition is conducted in a pan measuring 3 feet wide, 8 feet long and 2 feet deep. The pans are constructed of¼ inch mild steel. The pans are elevated off the ground by cement blocks. See photographs in Section A.

Propellant Pan

The propellant is layered on the bottom of the pan, no more that 6 inches deep, and ignited. Treatment of propellants and explosives in bags or bulk form in the propellant pan is limited by NAVSEA OP-5 operation procedures and the size of the pan. The maximum quantity of propellant to be burned on a daily basis will be limited by the lead content of the propellant. The Naval Weapons Station Earle EOD Detachment will know the lead content of propellants prior to burning from product specifications. For ninety (90) treatment days per year, two burn events per day may be conducted which allow for a maximum emission of 7.1 pounds of lead per day. For six (6) treatment days per year, two burn events per day may be conducted which allow for a maximum emission of seven-tenths (0.7) of a pound of lead per day. Burning of lead-containing propellants is limited to a maximum of ninety-six (96) treatment days per year. Propellant pan and small arms treatments with the 90-day higher lead content material cannot occur on the same day.

For those propellants not containing lead, the maximum quantity per event is limited to 800 pounds Net Explosive Weight (NEW), with two (2) events conducted per day for a total daily limit of 1600 pounds NEW. The Naval Weapons Station Earle EOD Detachment estimated a maximum 8 treatment days per month, assuming the maximum daily treatment. This results in a monthly treatment limit of 12,800 pounds NEW, a quarterly limit of 38,400 pounds NEW, and an annual limit of 153,600 pounds NEW. Although 8 days was used to estimate the monthly quantity, operations may be conducted 5 days per week as long as the per event, daily and monthly weight restrictions are not exceeded.

After the propellant has burned and cooled off, non-reactive residues are collected using brooms and shovels, and placed in DOT approved drums. Any remaining reactive material shall remain in the burn pan for further processing treatment in the next burn. All reactive material is completely disposed of prior to securing the EOD area. Samples for analysis are taken of the waste material in the drums prior to disposal to assist the Environmental Department in disposing of the waste material properly (See Section C-2).

Small Arms Pan

Treatment of waste ordnance in the small pan is limited to small arms ammunition 20mm or less. Typically, 50 caliber and smaller cartridges are treated. Treatment is assisted by dunnage (i.e., wooden boxes) and fuel oil. Dunnage is laid on the bottom of the pan with the small arms ammunition spread out over the dunnage. A small amount of diesel fuel is then poured over the contents (typically 1-3 gallons).

Small arms burns will be limited by the lead content of the energetic portion of the munition. For up to ninety (90) days per year, one small arms burn per day may be conducted, resulting in a maximum of 1.06 pounds of lead emitted. For up to one hundred and fifty (150) days per year, one small arms burn per day may be conducted, resulting in a maximum of one-tenth (0.1) pounds of lead emitted. Prior to burning, the Naval Weapons Station Earle EOD Detachment will know the lead content of the energetic portion of small arms from product specifications.

The Naval Weapons Station Earle EOD Detachment has estimated that up to 20 treatment events per month will be required, up to a maximum of 240 events per year. Propellant pan and small arms treatments with the 90-day higher lead content material cannot occur on the same day.

B-1c(2) Open Detonation (OD)

The second method of disposal, open detonation, takes place on the ground surface, or in earthen pits. There are normally five earthen pits, and one or all may be used at any given time. Detonations exceeding 5 pounds NEW must be conducted in the earthen pits and covered by 2 feet of earth. Detonations 5 pounds or less may be conducted on the surface. After each series of detonations (up to 5 detonations per series), a careful check of the EOD area and surrounding area for unexploded ammunition and explosive is conducted. All scrap metal and inert material is staged for removal. Fused ordnance items or any unstable ammunition not destroyed by the process, and which may be internally damaged, is destroyed in place by using additional explosives. Pieces of bulk explosives or unfuzed ordnance are collected and prepared for the next open detonation shot.

NAVSEA granted WPNSTA Earle a treatment limit of 50 pounds of OD. To limit the impact of noise due to OD, the Commanding Officer has set a maximum limit of 25 pounds per OD. Treatment above 10 pounds per pit is considered an emergency situation and requires the Commanding Officer's approval. WPNSTA Earle's operating and treatment limits based on the preceding condition are 10 pounds NEW per pit, times 5 pits, times a maximum number of 7 treatment events daily. As described above, NEW means that the weight of nonexplosive material is not part of the weight described, and with respect to OD includes any donor charge necessary to ensure safe detonation of the material. The limit requested under this permit application equates to a maximum daily rate of 350 pounds of explosives, treated in accordance with all other SOP requirements. This 350 pound NEW daily limit translates to a maximum quarterly treatment rate of 22,750 pounds NEW (assuming a maximum of 65 treatment days per quarter, times the maximum daily treatment rate); and a maximum annual treatment rate of 91,000 pounds NEW (assuming a maximum of 260 treatment days per year, times the maximum daily treatment rate).

OB/OD operations have been conducted at this location since the EOD area was certified by NAVSEASYSCOM in 1974. OD operations are conducted in the same manner today as when the EOD area was originally certified. OB operations were initially conducted by laying the burn material flat on the ground and igniting it. Today burn pans are used to prevent burn material from contacting and contaminating the soil. The general area that was used for the burns was in the same location as the demolition pits or slightly southwest, towards the safety shelter.

Records will be kept regarding the treatment of all energetic materials.

Ordnance is stored in ordnance magazines in accordance with the explosive storage requirements defined in NAVSEA OP 5.

At WPNSTA Earle, primary responsibility for coordinating hazardous waste (HW) management rests with the Public Works (PW) Department. Mr. Gus Hermanni, the Environmental Director assigned to the PW, is the primary contact and responsible party for HW management.

EXECUTIVE SUMMARY

An air pathway assessment was conducted to predict the impact of air emissions associated with Open Burning and Open Detonation treatment operations at the Naval Weapons Station (NWS) Earle. The air pathway assessment utilized air quality dispersion models to calculate the impact to receptors located at the NWS Earle boundary and the surrounding residential area. Results of the air dispersion modeling analysis were used in a risk assessment to estimate the probability of adverse health effects resulting from human exposure to treatment emissions. The results of the risk assessment are summarized below.

Cumulative Cancer Risk

The New Jersey Department of Environmental Protection (NJDEP) Risk Management policy guidance described in Technical Manual 1003 (Air Quality Regulation Program Bureau of Air Quality Evaluation Guidance on Preparing a Risk Assessment Protocol for Air Contaminant Emissions) states that if the incremental cancer risk from any ~~contaminant~~ evaluated is less than or equal to 1 in 1 million (1.0×10^{-6}), the risk is considered negligible. If the incremental cancer risk is between 1 in 1 million (1.0×10^{-6}) and 1 in ten thousand (1.0×10^{-4}), the risk is evaluated by the NJDEP on a case-by-case basis. no

The cumulative cancer risk for all contaminants at the 86 receptors evaluated, with the exception of nickel at the Closest Offsite Sensitive Receptor and nickel and chromium at the North 18 Boundary Receptor, were less than 1 in 1 million (1.0×10^{-6}) and therefore considered negligible. The cumulative cancer risk for nickel at the Closest Offsite Sensitive Receptor was 3.4×10^{-6}. The cumulative cancer risk for nickel and chromium at the North 18 Boundary Receptor was 4.92×10^{-6} and 1.23×10^{-6}, respectively. The NJDEP will evaluate the risk assessment results for nickel and chromium at the Closest Offsite Sensitive and North 18 Boundary receptors.

Cumulative Hazard Quotient

The NJDEP Risk Management policy guidance described in Technical Manual 1003 states that if the hazard quotient for any evaluated contaminant is less than or equal to 1, the risk is considered negligible. If the hazard quotient is greater than 1, the risk is evaluated by the NJDEP on a case-by-case basis. no

The initial air pathway assessment of open burning activities indicated that the cumulative 24-hour lead hazard quotients at the Closest Offsite Sensitive and North 18 Boundary receptors were 38 and 40, respectively. The Naval Weapons Station Earle and the NJDEP have reached an agreement to limit the amount of lead emitted from open burning at the propellant pans and the small arms pan. This limitation will reduce the cumulative 24-hour hazard quotients at the Closest Offsite Sensitive and North 18 Boundary receptors to 7.9 and 10.0, respectively.

Cumulative Ambient Air Concentrations

The cumulative worst case ambient air quality concentrations associated with NWS Earle treatment units and wind erosion are presented in Table E-2-28 along with estimated values for background air quality. The cumulative impact of NWS Earle sources and background air quality are compared to New Jersey ambient air quality standards (NJAAQS) and National Ambient Air Quality Standards (NAAQS) for all applicable averaging periods. The results of the comparison show that the cumulative impact for all regulated pollutants do not exceed NJAAQS and NAAQS.

A discussion of OB and OD treatment operations and wind erosion (WE) scenario is followed by a detailed explanation of the air pathway assessment process, which includes a description of the environmental setting, identification of potential air contaminants and associated emission factors, and dispersion modeling demonstrations. Results of the dispersion modeling analyses are then incorporated into the risk assessment process for assessing the impact to human health and the environment. The section concludes with a discussion of the potential uncertainties associated with the air pathway assessment and a summary of the results.

The conceptual approach presented also closely parallels the organization of the U.S. EPA "Checklist for Technical Review of RCRA Part B Permit Application for Subpart X Units." This checklist covers volumes and characteristics of wastes, operating conditions, atmospheric conditions surrounding the unit, and concludes with exposure pathway discussions. Other sections of this permit application address some of the issues associated with the air pathway, such as Section C on waste characteristics.

E-2-3 OB/OD OPERATING CONDITIONS; [40 CFR 264.601(c)(1),(2),and (3), 270.23 (a) (2), and (b)]

NWS Earle thermal treatment operations are conducted at the Explosive Ordnance Disposal area. OB is conducted at the propellant pan (PP) and small arms pan (SA). OD is conducted at the OD pit area. The following subsections describe OB and OD operations and treatment limits used to evaluate compliance with environmental performance standards applicable to the air pathway.

E-2-3a <u>Materials to be Treated in OB/OD Units</u>

The materials to be treated at the OB/OD units are Listed in Appendix E-2-1 of this permit application and are described in Section C, Waste Characterization. All items are reactive wastes, and their energetic constituents have been fully described in Section C. No liquids are treated at either the OB or OD units. Emission factors for potential air contaminants are described in Section E-2-4b using constituent compositions and OB/OD emissions test data.

Because of the numerous ordnance items that may require treatment at NWS Earle, it is not possible to characterize them all. The wastes characterized in Section C are representative of the primary materials that will be treated on a regular basis. When a material that was not characterized in Section C requires treatment, the procedures presented in Section C-1g(2) will be followed to determine at what quantity the new material can be safely treated.

E-2-3b <u>Preburn Emissions</u> [40 CFR 264.601(c)(2), 270.23(d)]

Prior to conducting treatment operations, energetic materials are placed either in burn pans for OB or in earthened pits for OD. In the case of OB, propellant material is carefully spread out in the burn pan. Propellants are typically granulated or pellet-like substances. Resuspension of these materials into the air would require high wind speeds. Propellants and explosives are not volatile. Propellants and explosives that are treated in the small arms pan are totally enclosed in metal casings that preclude preburn emissions. Additional details on the construction and design of the burn pans are provided in Section D.

During the OD process, solid materials are placed in a pit or on the surface and are exposed to the environment for a short period of time. Almost all energetics are enclosed in a casing (shell, projectile, etc.). Therefore, emissions prior to treatment will not occur for either OB or OD.

E-2-3c <u>Treatment at SOP Limits (Operating Conditions)</u>

NWS Earle treats reactive materials at specified quantities as described below in Sections E-2-3c(1) and E-2-3c(2) for OB and OD, respectively. All treatment quantity limits discussed in this permit application are Net Explosive Weight (NEW) of energetic material. The weight of nonenergetic material is not part of the weight described.

Each treatment unit has established frequencies for which treatment of reactive material can occur. These frequencies have been established for daily, quarterly and annual periods and are described below.

Treatment Unit	Maximum Treatment Events per Day	Maximum Treatment Events per Quarter	Maximum Treatment Days per Year
PP*	2	24	96
SA*	1	60	240
OD	7	65	260
WE	N/A	N/A	N/A

N/A - Not applicable.
* These treatment units can operate at the maximum number of events per period and still maintain compliance with the lead emission limitations.

The air pathway assessment for OB and OD treatment has been conducted using the maximum allowable treatment events and days per quarter and annual period for each treatment unit.

E-2-3c(1) Open Burning (OB)

Propellant Pan (PP)

Treatment of propellants and explosives in bags or bulk form in the propellant pan is limited. The propellant is layered on the bottom of the pan, no more that 6 inches deep, and ignited. Treatment of propellants and explosives in bags or bulk form in the propellant pan is limited by NAVSEA OP-5 operation procedures and the size of the pan. The maximum quantity of propellant to be burned on a daily basis will be limited by the lead content of the propellant. The Naval Weapons Station Earle EOD Detachment will know the lead content of propellants prior to burning from product specifications. For ninety (90) treatment days per year, two burn events per day may be conducted which allow for a maximum emission of 7.1 pounds of lead per day. For six (6) treatment days per year, two burn events per day may be conducted which allow for a maximum emission of seven-tenths (0.7) of a pound of lead per day. Burning of lead-containing propellants is limited to a maximum of ninety-six (96) treatment days per year. Propellant pan and small arms treatments with the 90-day higher lead content material cannot occur on the same day.

For those propellants not containing lead, the maximum quantity per event is limited to 800 pounds Net Explosive Weight (NEW), with two (2) events conducted per day for a total daily limit of 1600 pounds NEW. The Naval Weapons Station Earle EOD Detachment estimated a maximum 8 treatment days per month, assuming the maximum daily treatment. This results in a monthly treatment limit of 12,800 pounds NEW, a quarterly limit of 38,400 pounds NEW, and an annual limit of 153,600 pounds NEW. Although 8 days was used to estimate the monthly quantity, operations may be conducted 5 days per week as long as the per event, daily and monthly weight restrictions are not exceeded.

Small Arms Pans (SA)

Treatment of waste ordnance in the small arms pan is limited to small arms ammunition 20mm or less. Typically, 50 caliber and smaller cartridges are treated. Treatment is assisted by dunnage (i.e., wooden boxes) and fuel oil. Dunnage is laid on the bottom of the pan with the small arms ammunition spread out over the dunnage. A small amount of diesel fuel is then poured over the contents (typically 1-3 gallons).

Small arms burns will be limited by the lead content of the energetic portion of the munition. For up to ninety (90) days per year, one small arms burn per day may be conducted, resulting in a maximum of 1.06 pounds of lead emitted. For up to one hundred and fifty (150) days per year, one small arms burn per day may be conducted, resulting in a maximum of one-tenth (0.1) pounds of lead emitted. Prior to burning, the Naval Weapons Station Earle EOD Detachment will know the lead content of the energetic portion of small arms from product specifications.

The Naval Weapons Station Earle EOD Detachment has estimated that up to 20 treatment events per month will be required, up to a maximum of 240 events per year. Propellant pan and small arms treatments with the 90-day higher lead content material cannot occur on the same day.

E-2-3c(2) Open Detonation (OD)

NAVSEA has determined a treatment limit of 50 pounds NEW per OD event. To limit the impact of noise due to OD, the Commanding Officer has set a maximum limit of 25 pounds per OD. Treatment above 10 pounds is considered an emergency situation and requires the NWS Earle Commanding Officer's approval. In addition, treatment of greater than 5 pounds requires a subsurface detonation. NWS Earle's operating and treatment limits, based on the preceding condition, are 10 pounds NEW per pit, times five pits, times a maximum number of seven treatment events daily. As described above, NEW means that the weight of nonexplosive material is not part of the weight described, and with respect to OD includes any donor charge necessary to ensure safe detonation of the material. This limit equates to a maximum daily limit of 350 pounds of explosives, treated in accordance with all other SOP requirements. This 350-pound daily limit translates to a maximum quarterly treatment rate of 22,750 pounds (assuming a maximum of 65 treatment days per quarter, times the maximum daily treatment rate) and a maximum annual treatment rate of 91,000 pounds (assuming a maximum of 260 treatment days per year, times the maximum daily treatment rate). Maximum treatment quantities for OB and OD, in pounds of NEW, for specified time periods are summarized below.

Maximum Treatment Quantity Limits in Pounds (NEW)				
Treatment Operation	**Per Event**	**Daily Limits**	**Quarterly Limits**	**Annual Limits**
Propellant Pan (PP)*	800	1,600	38,400	153,600
Small Arms Pan (SA)*	50	50	3,000	12,000
Open Detonation (OD)	50	350	22,750	91,000

* The maximum treatment quantities listed for the PP and SA are for treating items not containing lead. The limitations on lead treatment and emissions from these treatment units are described in Section E-2-3c(1).

All modeling demonstrations conducted in this air pathway assessment, with the exception of the wind erosion scenario, are based upon treatment at the "maximum per event" limits shown above to calculate a worst-case, 1-hour concentration. Worst case, 1-hour concentrations have been extrapolated to longer averaging periods in accordance with the daily, quarterly, and annual maximum treatment quantity limits. Limitations associated with the treatment processes are described in the SOPs for NWS Earle and in Section D of this permit application.

E-2-3d <u>Wind Erosion Emission Scenario</u>

In addition to addressing the impact of air emissions from OB and OD operations, the air pathway assessment also evaluated the impact of emissions from the wind erosion resuspension of contaminated surface soil from the EOD treatment area. Over time, it is expected that energetic constituents or OB/OD combustion products can be transferred to the nearby surface soil due to treatment operations. NAVSEA regulations require the EOD treatment area to be devoid of vegetation to greatly reduce fire potential. As a result, this area has a higher potential for wind blown dust as compared to an area covered by vegetation.

In the air pathway assessment, wind erosion emissions are assumed to be emitted from a vegetation-free, 122 meter (m) by 122 m square area (14,884 m^2) that comprises that EOD operations for OB and OD. The actual area in which OB and OD takes place makes up less 100 m^2. A much larger emission area has been assumed to account for blow out from the OD pits and possible impact from the OB air emissions. The list of potential chemicals of concern and the basis for estimating contaminant emission rates were obtained from annual EOD soil sampling conducted for the annual periods 1992 through 1995.

Additional information regarding the wind erosion analysis can be found in Sections E-2-4b, E-2-4c and E-2-5.

E-2-4 AIR PATHWAY ANALYSIS [40 CFR 264.601(c)(1) and (3), 264.602]

The following subsections describe environmental conditions, potential air emissions, and air dispersion modeling protocols and assumptions that were used to conduct the air pathway analysis for this assessment.

E-2-4a Environmental Setting

E-2-4a(1) Topography

Natural Features

The Mainside area of NWS Earle lies within the Atlantic Coastal Plain Physiographic Province. The mostly wooded Mainside is situated within New Jersey's Outer Coastal Plain and is affected by the numerous creeks and streams that form the headwaters of Monmouth County's major rivers.

Topography/Slopes

The physiographic pattern of the Mainside is dominated by an east-west ridge, known as Hominy Hills, which runs through the central portion of NWS Earle. The highest point is Throckmorton Hill, which rises to an elevation of 307 feet above mean sea level (MSL). Other prominent mounds in this series of hills include Cranberry, Lippincott, and Oak Hills, The Mainside administrative area and the Wayside area are relatively level with elevations ranging from approximately 80-160 feet above MSL. Steep slopes, those above 15 percent, are limited in these two areas and pose minimal constraints for new development.

OB/OD Physical Characteristics

The EOD area where OB/OD treatment takes place is approximately 15.5 acres in size and appears as a shallow, wide open, nonvegetated, oval-shaped sand pit with a high berm and is bordered by woodlands. Two undeveloped dirt roads access the site, one from the south, and one from the direction of Piney Brook. The topography at the site slopes gently toward the north from approximately 125 feet above MSL at the bunker to approximately 90 feet MSL in the OD area. An elongated sand berm approximately 200 feet long and 15 feet high, oriented northeast to southwest, is situated in the center of the site. Virtually all OB and OD treatment takes place in the northeast quadrant of the EOD area, east of the elongated berm.

E-2-4a(2) Land Use Classification

All land within 3,000 feet of the EOD area is either undeveloped woodlands or munitions storage areas. New Jersey has formulated a development strategy that categorizes land in a series of seven tiers which define growth, nongrowth, and preservation areas within the State. Tiers 5 through 7 are designated as nongrowth or limited future growth areas. Off-station lands within 1 mile of the EOD range are categorized as Tiers 6 and 7.

For the purpose of conducting the air dispersion modeling analysis, the selection of rural or urban dispersion coefficients was determined using the procedure suggested in U.S. EPA modeling guidance. This procedure includes a land use classification within 3 kilometers (km) of the source. A review of United States Geological Survey USGS topographic maps for the area within 3 km of NWS Earle indicates that more than 80 percent of the total area constitutes land use types that support the use of rural dispersion coefficients.

E-2-4a(3) Meteorology/Climatology [40 CFR 264.601 (c)(4)]

Because of its location near the coastline, Monmouth County is subject to easterly storms throughout late summer and early fall, causing high tides and flooding. Intense tropical hurricanes occasionally sweep the coast. The winter is characterized by storms that move along the eastern seaboard. The storms from the north are associated with high winds and precipitation in the form of snow, ice pellets, or rain; however, the snow is seldom prolonged and generally results in little accumulation.

Spring is a period of contrasting weather. Spring and autumn are periods of frost. Summer is warm and humid with occasional showers and thunderstorms. Ground fog is a frequent weather occurrence in the summer, especially during the early morning hours. Autumn is a season of comfortable temperatures (average temperatures range from 50° to 60°F) and generally pleasant weather.

Wind Patterns

Because of the lack of available onsite meteorological data, the Newark New Jersey airport; located approximately 50 miles north of Earle; was selected as a representative station for climatology and meteorological information. Newark was selected because meteorological conditions would best approximate those at NWS Earle based on similar topography and proximity to the coastline.

Five years (1988-1992) of hourly meteorological data for Newark were downloaded from the Support Center for Regulatory Air Models Bulletin Board (SCRAMS BBS) and processed to create a wind rose showing the frequency distribution of wind speed and wind direction. This data were input into a wind-rose program to calculate five separate annual frequency distributions. The five frequency distributions were combined into a composite (5-year) frequency distribution, as illustrated in Figure E-2-3. These data indicate that the prevailing wind direction is from the southwest with an annual average velocity of about 4.56 meters/second (10.2 miles per hour or mph). Since NWS Earle lies inland, mesoscale meteorological effects, such as sea and land breezes, are minimized with increasing distance from the coastline. Sustained winds tend to be higher during the period November through May, averaging about 11-12 mph. Conversely, the summer months tend to produce highest wind gusts as a result of thunderstorms.

Precipitation

Normal annual precipitation for the Newark area is about 42 inches, which includes both rain and snowfall events. Monthly averages range from a minimum of 2.94 inches in June to a maximum of 4.30 inches in August. The highest daily rainfall occurs during the late summer months when as much as 7.84 inches fell in a 24-hour period. Average snowfall is about 29 inches from November through April. Occasionally, in late summer and early fall, tropical storms may sweep the coast producing copious amounts of rain over a few days. Likewise in winter, large, low-pressure systems tend to form along the coast resulting in heavy rain or snowfall.

Evaporation Rate

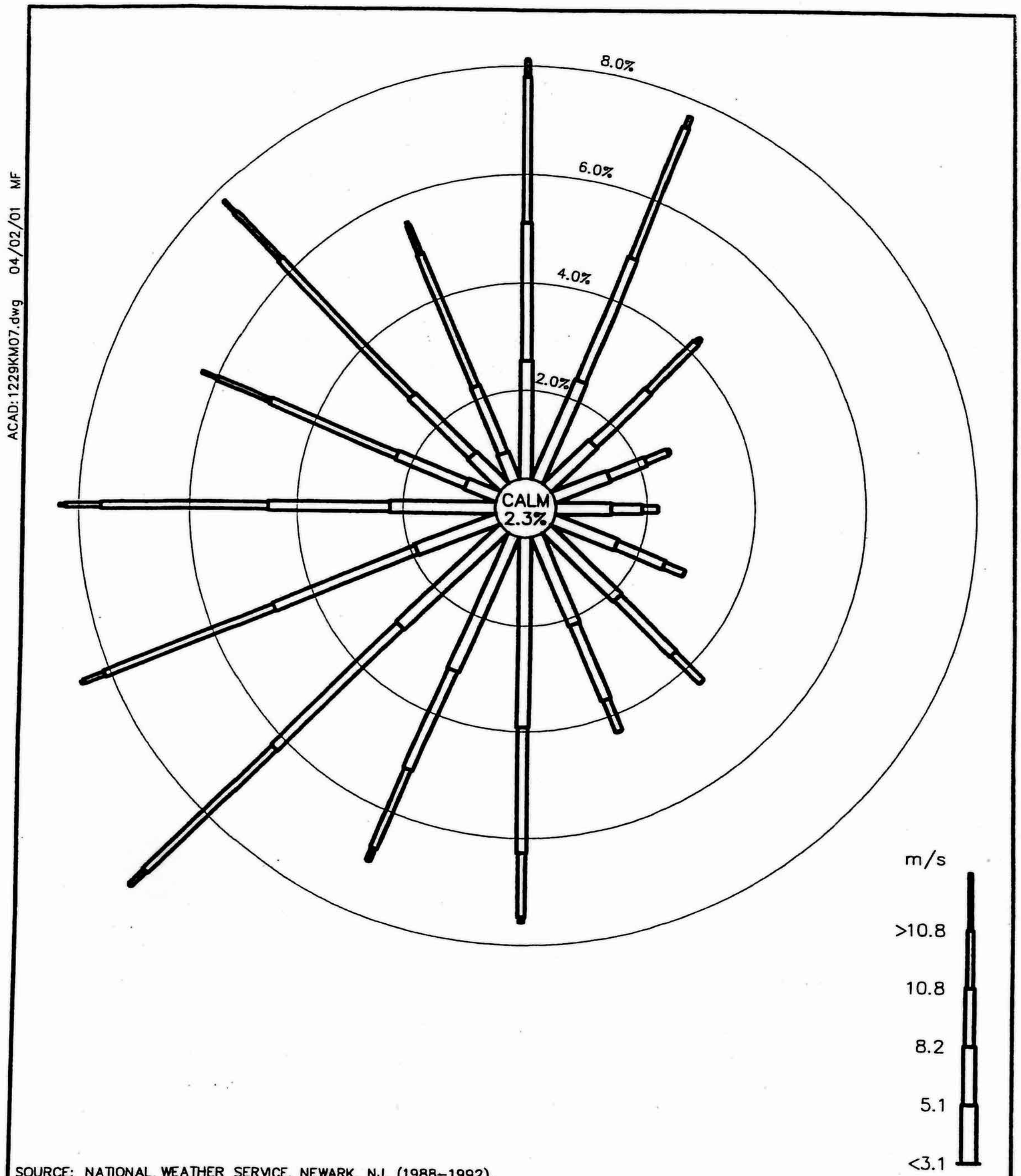
Mean annual lake evaporation is approximately 33 inches. Mean annual pan evaporation is about 43 inches. This information is based on data from 1946 to 1955 for the Newark area (Climatic Atlas of the United States).

Temperatures

The Main Base area of NWS Earle is characterized by a predominantly continental climate with significant seasonal and daily temperature fluctuations. Mean annual temperatures range from a maximum of 62.5°F to a minimum of 45.9°F.

Normal monthly high and low temperatures range from 38.2°F and 24.2°F in January to 85.6°F and 67.9°F in July. Diurnal temperature fluctuations of 5° to 20°F are common and dependent on cloud cover and precipitation. Freezing temperatures occur intermittently from October to April. The average first frost occurs around mid-October, and the average last frost occurs toward the end of April. The remaining period allows for an average growing season of approximately 198 days.

Figure E-2-3



SOURCE: NATIONAL WEATHER SERVICE, NEWARK, NJ. (1988–1992).

DRAWN BY MF / DATE 4/2/01	Tetra Tech NUS, Inc.	CONTRACT NO. 1229	OWNER NO. –––––
CHECKED BY / DATE	FIVE YEAR COMPOSITE WIND ROSE NAVAL WEAPONS STATION EARLE	APPROVED BY	DATE
COST/SCHED–AREA		APPROVED BY	DATE
SCALE NONE		DRAWING NO. FIGURE E–2–3	REV. 0

FORM CADD NO. TtNUS_AV.DWG – REV 0 – 1/22/98

Temperature Inversions

Inversions are defined as a condition in a layer of the lower atmosphere in which temperature increases with altitude as opposed to the normal decrease with altitude. Temperature inversions form when stratified layers of air cool at different rates. Generally, the air closest to the land cools at a faster rate than the air above it. The phenomenon results in a layer of warmer air over cooler air. Temperature inversions can occur almost daily with varying degree of strengths. The inversion strengths are defined as the difference between surface temperatures and the warmest temperature aloft. Inversions generally form overnight and dissipate shortly after sunrise. Inversions are strongest during the autumn, when longer nights provide greater radiational cooling, and in winter, when clear skies and fresh snow cover are present.

Mean morning mixing heights range from 900 meters in winter to 700 in summer. Mean afternoon mixing heights range from 900 meters in winter to 1,600 meters in summer and spring.

Relative Humidity

Relative humidity varies throughout the day with highest humidity occurring in the morning hours and lowest during the afternoon. Mean annual humidities range from 74 percent during the morning hours shortly after sunrise to 54 percent during the early afternoon hours. Cloud cover tends to limit these fluctuations in humidity.

E-2-4a(4) Existing Air Quality [35 IAC 703.209, 724.701 D-8(c)(5); 40 CFR 264.601(c)(5)]

NWS Earle is within the New Jersey-New York-Connecticut Air Quality Control Region (AQCR) #43. This AQCR includes nine counties in North and Central New Jersey ranging in use from heavy industrial to rural. Air quality attainment status designations for the criteria pollutants indicate that Monmouth County is designated as attainment/unclassified for all criteria pollutants but ozone. Ozone for Monmouth County is classified as Nonattainment/Severe-1.

Monmouth County is within Reporting Region 6 of the State of New Jersey. Ambient air quality monitoring is conducted at only two locations within Monmouth County. Air monitoring is conducted for ozone (O_3) at Monmouth College and at Carbon Monoxide (CO) and Smoke Shade Coefficient of Haze (COHS) in Freehold, New Jersey. These stations are located, respectively, approximately 13 miles northeast and 9 miles northwest of NWS Earle. Air quality data for the remaining Federal criteria pollutants and New Jersey air quality standards were obtained from the nearest air monitoring stations within the surrounding counties. These stations included Perth Amboy for sulfur dioxide (SO_2) Lakewood for total suspended particulate (TSP), East Brunswick for inhalable particulate matter (PM10), and Plainfield for nitrogen dioxide (NO_2) and nitrogen oxides (NO_x). In the case of lead (Pb), the Jersey City monitoring station was selected because it is more representative of land use characteristics in the vicinity of NWS Earle than the nearest Pb monitoring station at New Brunswick, which has major sources of lead.

A summary of the criteria pollutant air quality data for the 3-year period 1993-1995 relative to Federal and New Jersey air quality standards are presented in Table E-2-1. A review of Table E-2-1 indicates exceedances of the New Jersey and National ozone primary standard at Monmouth College in 1995.

E-2-4a(5) Local Air Emissions Data

Emissions inventory data were obtained for sources within Monmouth County, New Jersey. The information was obtained from the New Jersey Department of Environmental Protection and Energy (NJDEPE), Bureau of Air Quality Evaluation. The inventory contained data for sources of volatile organic compounds (VOCs), nitrogen oxides (NO_x), and carbon monoxide (CO). Total emissions for these pollutants in tons/year are VOC: 2963; NO_x: 1557; and CO: 38. These quantities have been adjusted by the NJDEPE to account for uncertainties in the emissions data submitted by the sources.

TABLE E-2-1

SUMMARY OF AMBIENT AIR QUALITY DATA FOR MONITORING STATIONS CLOSEST TO NWS EARLE (1993-1995)
NAVAL WEAPONS STATION EARLE

Criteria Pollutant	Highest Concentration (ppm)*	Second Highest Concentration (ppm)*	New Jersey Standard (ppm)*	Federal Standard (ppm)*
SO_2 (Primary, 24-hr)[a]	-	0.030 Perth Amboy (1994)	.14	.14
SO_2 (Primary, Annual)	.005 Perth Amboy (1994)		.03	.03
SO_2 (Secondary, 3-hr)**	-	0.042 Perth Amboy (1994)	.50	.50
SO_2 (Secondary, 24-hr)**	-	0.030 Perth Amboy (1994)	.10	-
SO_2 (Secondary, Annual)**	.005 Perth Amboy (1994)		.02	-
O_3 (Primary, 1-hr)[b]	-	0.146 Monmouth College (1995)	.12	.12
TSP (Primary, 24-hr)[a]	-	75 $\mu g/m^3$ Lakewood (1995)	260	-
TSP (Primary, Annual)[c]	31$\mu g/m^3$ Lakewood (1994)		75	-
TSP (Secondary, 24-hr)		100 $\mu g/m^3$ Lakewood (1995)	150	-
TSP (Secondary, Annual)[c]	22$\mu g/m^3$ Lakewood (1994)		60	-
PM10 (24-hr)[a]	-	51.0 $\mu g/m^3$ E. Brunswick (1994)	-	150
PM10 (Annual)	23.3 $\mu g/m^3$ E. Brunswick (1994)		-	50
CO (1-hr)[a]	-	10.6 Freehold (1994)	35	35
CO (8-hr)[a]	-	6.4 Freehold (1993)	9	9
Pb (Quarter)	0.053 $\mu g/m^3$ Jersey City (1993)		1.5[c]	1.5[c]
NO_2 (Annual)	.024 Plainfield (1993)		.05	.05

a Concentration not to be exceeded more than once per year.
b Concentration not to be exceeded more than an average of 1 day/year.
c annual geometric mean.
* ppm = parts per million, TSP, PM10, and lead concentrations are in $\mu g/m^3$.
TSP = Total suspended particulate
PM10 = Respirable particulate matter
** State of New Jersey secondary standard

E-2-4b Potential Air Emissions [40 CFR 264.601(c)(1)]

The air pathway assessment conducted for this permit application considered all sources of air emissions relative to NWS Earle OB/OD treatment processes. These sources include emissions from OB/OD thermal treatment processes and particulate emissions from wind erosion resuspension. The potential air emissions from OB and OD thermal treatment processes can include products of combustion, products of incomplete combustion (PICs), energetics, metals, and other inorganics. Potential air emissions for the wind erosion scenario include those contaminants which are the target compounds of the EOD soil sampling program.

Each of these air-pathway release mechanisms is considered in the air pathway assessment. Further information regarding the derivation of potential chemicals of concern and emission factors or rates is discussed below in Sections E-2-4b(1) through E-2-4b(3).

E-2-4b(1) Potential Chemicals of Concern

Potential chemical emissions of concern from the OB and OD units include products of combustion, as well as products of incomplete combustion. Energetic compounds are composed principally of carbon, hydrogen, nitrogen, and oxygen. The primary air emissions are products of combustion, which typically include the following:

- Carbon monoxide
- Carbon dioxide
- Nitrogen and nitrogen oxides
- Water
- Sulfur dioxide
- Methane

Secondary air emissions include various products of incomplete combustion (which can include energetic materials, organics, and trace metals).

A list of potential chemicals of concern for the individual thermal treatment units (OB propellant pan, OB small arms pan, and OD pit) and the wind-erosion emission scenario are provided in Table E-2-2. This list was developed from three sources of information: results of special emission characterization tests conducted by the Army and Air Force for OB and OD, mass balance assumptions for trace metals (inorganics), and the assumed destruction and removal efficiency (DRE) for energetic materials. Additional information regarding the testing conducted by the Army and Air Force is provided in Appendix E-2-2. Potential chemicals of concern for the wind erosion scenario were obtained from the list of target analytes evaluated in the EOD surface soil sampling program.

In addition to the list of potential chemicals of concern, Table E-2-2 also indicates which chemicals have been selected as emission products for the individual treatment units and the wind erosion scenario. Chemical emissions associated with each source are marked with an "X". Also provided in Table E-2-2 are health criteria that were used to conduct the risk assessment discussed in Section E-2-5. These health criteria include Unit Risk Factors (URFs) and Reference Concentrations (RfCs) provided in the State of New Jersey, Technical Manual 1003, Air Quality Regulation Program, Bureau of Air Quality Evaluation, Guidance on Preparing a Risk Assessment Protocol for Air Contaminant Emissions (Revised December 1994) as well as ambient air quality standards for criteria pollutants and additional air quality standards regulated by the New Jersey (NJAQS). Chemicals having URFs, RfCs, National Ambient Air Quality Standards (NAAQS), and NJAQS are marked with an "X".

For the purpose of this air pathway assessment, only those chemicals having URFs, RfCs in Technical Manual 1003, NAAQS and NJAQS are evaluated in the risk assessment. Table E-2-3 shows the URF and RfC values obtained from Technical Guidance Technical Manual 1003. Applicable NAAQS and NJAQS for this analysis are

TABLE E-2-2

LIST OF POTENTIAL AIR CONTAMINANTS FROM INDIVIDUAL TREATMENT UNITS AND WIND EROSION NAVAL WEAPONS STATION EARLE

Potential Air Contaminants	Treatment Unit				URF	RfC	NAAQS*	NJAQS**
	OB Propellant Pan	OB Small Arms Pan	OD	Wind Erosion				
PICs								
1,3,5-Trinitrobenzene	X	X	X					
1,3-Butadiene			X		X			
1,4-Dichlorobenzene			X			X		
1,6-Dinitropyrene	X	X						
1-Nitropyrene	X	X	X					
2,2'-Methylene bis(4-methyl-6-t-butyl phenol)	X	X						
2,4-Dinitrotoluene	X	X	X		X			
2,6-Dinitrotoluene	X	X	X					
2-Methylnaphthalene			X					
2-Methylphenol			X					
2-Naphthylamine	X	X						
2-Nitrodiphenylamine	X	X	X		X			
2-Nitronaphthalene	X	X	X					
4-Nitrophenol			X					
5-Ethyl-1,3-diglycidyl-5-methylhydantoin diepoxide	X	X						
Acenaphthalene			X					
Acetophenone			X			X		
alpha,alpha-Dimethylphenethylamine			X					
Ammonia	X	X	X			X		
Anthracene			X					
Aromatics (VOs, including benzene)			X					
Benz[a]anthracene	X	X	X					
benz[c]acridine	X	X						
Benzene	X	X	X		X	X		
Benzo[a]pyrene	X	X	X		X			
Benzo[b]fluoranthene			X					

TABLE E-2-2

LIST OF POTENTIAL AIR
CONTAMINANTS FROM INDIVIDUAL TREATMENT UNITS AND WIND EROSION
NAVAL WEAPONS STATION EARLE
PAGE 2 OF 4

Potential Air Contaminants	Treatment Unit				URF	RfC	NAAQS*	NJAQS**
	OB Propellant Pan	OB Small Arms Pan	OD	Wind Erosion				
Benzo[k]fluoranthene			X					
benzyl alcohol			X					
Butylbenzylphthalate			X					
Chrysene			X					
Di(2-ethylhexyl)phthalate			X					
Di-n-butylphthalate			X					
Di-n-octylphthalate			X					
Di-n-propyladipate	X	X						
Dibenz[a,h]anthracene	X	X	X					
Dibenzofurans	X	X	X					
Diethylenetriamine	X	X						
Diethylphthalate	X	X	X					
Dimethylphthalate			X					
Dioctylsebacate	X	X						
Diphenylamine	X	X	X					
Ethylbenzene			X			X		
Fluorene			X					
Fluroanthene			X					
Hexane			X			X		
Hydrogen cyanide	X	X	X					
Isophoronedi-isocyanate	X	X						
Methane	X	X	X					
N-Nitrosodiethylamine			X		X			
N-Nitrosodiphenylamine	X	X	X		X			
Naphthalene	X	X	X					
Nitric Oxide	X	X	X					
o-Nitrophenol	X	X						
Olefins (VOs)			X					
Parafins (VOs)			X					
Phenanthrene			X					

TABLE E-2-2

LIST OF POTENTIAL AIR
CONTAMINANTS FROM INDIVIDUAL TREATMENT UNITS AND WIND EROSION
NAVAL WEAPONS STATION EARLE
PAGE 3 OF 4

Potential Air Contaminants	Treatment Unit				URF	RfC	NAAQS*	NJAQS**
	OB Propellant Pan	OB Small Arms Pan	OD	Wind Erosion				
Phenol	X	X	X			X		
Phenyldiisodecylphosphite	X	X						
Picric acid			X					
Pyrene	X	X	X					
Resorcinol	X	X						
Styrene			X		X	X		
TNMHC	X	X	X					
TO-12 (Total organics C2-C15)			X					
Toluene			X			X		
Triacetin	X	X						
Xylenes (isomers and mixtures)			X			X		
Organic Constituents								
1,3,5-Trinitrotoluene	X	X						
Dinitrotoluene	X	X		X	X			
HMX	X	X						
Nitroglycerin	X	X						
Nitroguanidine	X	X						
RDX	X	X						
Tetryl	X							
Inorganic Constituents								
Antimony				X				
Arsenic				X	X			
Barium	X	X	X	X		X		
Beryllium				X	X			
Boron			X			X		
Cadmium				X	X			
Chromium			X		X	X		
Copper	X			X		X		
Lead	X	X	X	X		X		
Mercury				X		X		

LIST OF POTENTIAL AIR CONTAMINANTS FROM INDIVIDUAL TREATMENT UNITS AND WIND EROSION - NAVAL WEAPONS STATION EARLE

Potential Air Contaminants	Treatment Unit				URF	RfC	NAAQS*	NJAQS**
	OB Propellant Pan	OB Small Arms Pan	OD	Wind Erosion				
Nickel			X		X			
Selenium				X	X	X		
Silver				X				
Thallium				X				
Vanadium				X				
Zinc	X	X	X	X		X		
Criteria Pollutants								
Carbon monoxide	X	X	X				X	X
Lead	X	X	X	X			X	X
Nitrogen dioxide	X	X	X				X	X
Ozone							X	X
PM-10	X	X	X				X	
Sulfur dioxide	X	X	X				X	X
TSP				X				X

* National Ambient Air Quality Standard
** New Jersey Air Quality Standard
PIC Products of Incomplete Combustion

TABLE E-2-3

UNIT RISK FACTORS AND REFERENCE CONCENTRATIONS FOR CHEMICALS OF CONCERN NAVAL WEAPONS STATION EARLE

Chemicals	Unit Risk Factor ($\mu g/m^3$)-1	24-Hour RfC ($\mu g/m^3$)	Annual RfC ($\mu g/m^3$)
PICs			
1,3 Butadiene	2.80E-4		
1,4 Dichlorobenzene			8.00E+2
Acetophenone			2.00E-2
Ammonia			1.00E+2
Benzene	8.30E-6	1.90E+1	
Benzo[a]pyrene	1.70E-3		
Ethylbenzene		1.00E+3	
Hexane			2.00E+2
N-Nitrosodiethylamine	4.30E-2		
N-Nitrosodiphenylamine	1.40E-6		
Phenol			4.50E +1
Styrene	5.70E-7		1.00E+3
Toluene			6.80E+1
Xylenes (isomers and mixtures)		1.65E+2	
Organic Constituents			
2,4-Dinitrotoluene	8.90E-5		
Inorganic Constituents			
Arsenic	4.30E-3		
Barium			5.00E-1
Beryllium	2.40E-3		
Boron			2.00E+1
Cadmium	3.50E-3		
Chromium	1.20E-2		2.00E-3
Copper			1.30E-1
Lead		1.00E-1	
Mercury			3.00E-1
Nickel	2.40E-4*		
Selenium	1.40E-4		5.00E-1
Zinc			2.00E-1

RfC - Reference Concentrations
PIC - Products of Incomplete Combustion
* - The URF for nickel applies to nickel refinery dust, not nickel subsulfide.

listed in Table E-2-1. Information regarding the derivation of OB, OD, and wind-erosion emission factors and emission rates for those chemicals being evaluated in the risk assessment is discussed below in Sections E-2-4b(2) and E-2-4b(3).

E-2-4b(2) OB/OD Emission Factors

Direct measurement of air emissions on a site-specific basis is not practical because of the extremely violent nature and short-term duration of emissions from OB/OD treatments. The U.S. Army (AMCCOM) and Air Force (USAFACC) have conducted special tests to characterize emissions from OB and OD. Detailed information regarding the AMCCOM and USAFACC testing programs is presented in Appendix E-2-2.

The emission factors for OB and OD were derived from actual measurements of emissions from "Bang Box" tests conducted at the Sandia National Laboratories at Albuquerque, New Mexico, and at Dugway Proving Grounds in Utah. In addition, field studies were conducted at Dugway Proving Grounds to confirm that the Bang Box tests were representative of actual field burns or detonations. In all, a total of six Bang Box tests and six field tests were available for OD emission factor calculations and a total of two Bang Box tests and five field tests were available for calculation of OB emission factors. Not all of these tests monitored all organics for which emission factors were calculated. In some cases, as few as one or two values were monitored (instead of the maximum of 12 OD tests or 7 OB tests). In some of the tests in which values below detection were reported, the detection limit was not available. To make use of these tests in which the values reported were below detection, a global value of 1.0E-8 was used (as a "global" detection limit) when this was noted in the report. In the case of tests where no information was available at all for the detection limit, the lowest value reported in other tests was substituted for the detection limit. The emission factors for Products of Incomplete Combustion (PICs) were applied across the board to each pound of NEW treated.

An approach has been developed for determining air emission factors utilizing data from the emission studies and constituent compositions. The approach for developing OB and OD emission factors ACC emission studies is based on the following:

- OB/OD emission tests conducted by the U.S. Army and U.S. Air Force.
- Mass balance assumptions for metals.
- Destruction Removal Efficiency (DRE) applied to energetic constituents.

Tables E-2-4 through E-2-6 list the base emission factors from Appendix E-2-2 for OB and OD, respectively. Emission factors are provided in units (e.g. pounds) of the constituent emitted per unit (e.g. pounds) of waste treated. Metallic constituents that are present in the waste feed are assumed to be emitted completely, i.e., the Destruction Removal Efficiency (DRE) is 0 percent. If the waste constituent is an organic, it is assumed to be emitted with a DRE of 99.99 percent for OB/OD. This is considered a conservative assumption, since the OB/OD emission tests conducted by the U.S. Army and U.S. Air Force demonstrate that the actual DREs are one to three orders of magnitude greater (99.999 percent to 99.99999 percent). The emission factor for all organic constituents was selected from the larger of the calculated DRE factor (99.99 percent) or the factor from emission testing. Emission testing factors shown in Tables E-2-4 through E-2-6 for PP, SA, and OD were obtained from the summary tables in Appendix E-2-2. The value for the upper 95 percent confidence limit (UCL) was used unless it could not be calculated. The single test value was used in cases where the UCL was not available since only one test value was available.

For metal and organic constituents presented in Tables E-2-4 through and E-2-6, the chemical characterization data in Section C were evaluated to determine the maximum and average weight percent of the constituents in the group of items characterized for each treatment operation. The maximum weight percent was used in cases where a metal emission product was known to have a short-term RfC. The average weight percentage value was used for metals having a long-term URF or RfC.

To be conservative, only the items containing that constituent were used to calculate the average. In the case of barium, copper, chromium, and lead, the existence of ordnance components in the list of items to be treated has

TABLE E-2-4

SUMMARY OF OB PROPELLANT PAN (PP)
SHORT-TERM AND LONG-TERM AIR EMISSION FACTORS
(POUNDS EMITTED PER POUND TREATED)
NAVAL WEAPONS STATION EARLE

Emission Products	Emission Factor[1]	
Criteria Pollutants	**Short Term***	**Long Term****
PICs[2]		
Ammonia	2.00E-05	2.00E-05
Benzene	9.68E-05	5.6E-06
Benzo(a)pyrene	3.75E-07	1.5E-07
N-Nitrosodiphenylamine	6.10E-07	2.3E-07
Phenol	4.47E-06	2.3E-06
Organic Constituents[3]		
2,4-Dinitrotoluene	3.20E-06	3.20E-06
Inorganic Constituents[4]		
Barium	1.54E-03	1.54E-03
Copper	5.53E-05	5.53E-03
Zinc	5.00E-06	5.00E-06
Criteria Pollutants		
Carbon monoxide	6.14E-04	3.90E-04
Nitrogen dioxide	1.18E-03	7.50E-04
Sulfur dioxide	7.34E-04	2.50E-04
PM10	1.60E-02	1.1E-02
Lead	2.61E-02	2.61E-02

1 PIC emission factors obtained from 95% UCL (upper confidence limit).
2 Net Explosive Weight (NEW) based emission factor for PICs (products of incomplete combustion) were obtained from AMCCOM Bangbox test data.
3 Emission factors for Organic Constituents are based on 99.99% Destruction/Removal Efficiency (DRE).
4 Emission factors for inorganic constituents are based on mass balance (in=out)
* Short-term emission factors are for averaging periods equal to or less than 24 hours.
** Long-term emission factors are for quarterly and annual averaging periods.

TABLE E-2-5

SUMMARY OF OB SMALL ARMS PAN (SA)
SHORT-TERM AND LONG-TERM AIR EMISSION FACTORS
(POUNDS EMITTED PER POUND TREATED)
NAVAL WEAPONS STATION EARLE

Emission Products	Emission Factor[1]	
Criteria Pollutants	Short-Term*	Long-Term**
PICs[2]		
Ammonia	2.00E-05	2.00E-05
Benzene	9.68E-05	5.60E-06
Benzo(a)pyrene	3.75E-07	1.50E-07
N-Nitrosodiphenylamine	6.10E-07	2.30E-07
Phenol	4.47E-06	2.30E-06
Organic Constituents[3]		
2,4-Dinitrotoluene	3.20E-06	3.20E-06
Inorganic Constituents[3]		
Barium	1.12E-04	1.12E-04
Zinc	7.70E-05	7.70E-05
Criteria Pollutants		
Carbon monoxide	6.14E-04	3.90E-04
Nitrogen dioxide	1.18E-03	7.50E-04
Sulfur dioxide	7.34E-04	2.50E-04
PM10	1.60E-02	1.10E-02
Lead	2.61E-02	2.61E-02

1 PIC emission factors obtained from 95% UCL (upper confidence limit).
2 Net Explosive Weight (NEW) based emission factor for PICs (products of incomplete combustion) were obtained from AMCCOM Bangbox test data.
3 Emission factors for Organic Constituents are based on 99.99% Destruction/Removal Efficiency (DRE).
4 Emission factors for inorganic constituents are based on mass balance (in=out)
* Short-term emission factors are for averaging periods equal to or less than 24 hours.
** Long-term emission factors are for quarterly and annual averaging periods.

TABLE E-2-6

SUMMARY OF OD
SHORT-TERM AND LONG-TERM AIR EMISSION FACTORS
(POUNDS EMITTED PER POUND TREATED)
NAVAL WEAPONS STATION EARLE

Emission Products	**Emission Factor[1]**	
Criteria Pollutants	**Short-Term***	**Long-Term****
PICs[2]		
1,3-Butadiene	1.44E-05	6.56E-06
1,4-Dichlorobenzene	2.79E-07	2.60E-07
Acetophenone	1.76E-07	1.54E-07
Ammonia	2.92E-04	2.92E-04
Benzene	2.39E-04	1.30E-04
Benzo(a)pyrene	1.39E-07	8.20E-07
Ethyl benzene	2.38E-05	1.03E-05
Hexane	1.86E-05	8.004E-06
N-Nitrosodiethylamine	1.20E-07	1.20E-07
N-Nitrosodiphenylamine	1.05E-06	4.15E-07
Phenol	4.47E-06	2.30E-06
Styrene	1.03E-03	4.28E-04
Toluene	1.56E-04	6.67E-05
Xylenes (isomers and mixtures)	1.34E-04	5.42E-05
Organic Constituents[3]		
2,4-Dinitrotoluene	5.20E-06	5.20E-06
Inorganic Constituents[4]		
Barium	1.74E-03	1.74E-03
Boron	1.13E-02	1.13E-02
Chromium	4.00E-06	4.00E-06
Nickel	8.0E-04	8.0E-04
Zinc	7.10E-05	7.10E-05
Criteria Pollutants		
Carbon Monoxide	5.15E-02	3.88E-02
Nitrogen Dioxide	2.04E-03	1.34E-03
Sulfur Dioxide	2.23E-04	2.23E-04
PM10	4.00E-01	2.40E-01
Lead	7.10E-05	7.10E-05

1 PIC emission factors obtained from 95% upper confidence level (UCL).
2 Net Explosive Weight (NEW) based emission factor for PICs were obtained from AMCCOM Bangbox test data.
3 Emission factors for Organic Constituents are based on 99.99% Destruction/Removal Efficiency (DRE).
4 Emission factors for inorganic constituents are based on mass balance (in=out)
* Short-term emission factors are for averaging periods equal to or less than 24 hours.
** Long-term emission factors are for quarterly and annual averaging periods.

artificially increased the percentage of metal in the emission factor. For example, lead azide is 100 percent of the NEW in items such as detonators and primers. But these items contain only a few grains of NEW and therefore contribute less than 1 percent of the NEW in a cartridge or projectile. For this reason, the maximum amount of these metal constituents which would be treated in an ordnance item, such as a cartridge or projectiles, was used as the emission factor for this assessment. This procedure is applicable because the NWS Earle does not have breakdown facilities and therefore treats only full rounds and projectiles and not components individually. In addition, donor explosive which contains no metals, typically comprises in excess of 50 percent of each open detonation.

Lead is the only metal emission that has a short term ((RfC) criteria. As a result, for OB, the lead emission factors for the PP and SA in Tables E-2-4 and E-2-5 are maximum weight percents. The emission factors for the quarterly and annual exposure periods were 6.26E-04 and 3.81E-03 pound/pound for the propellant pan and small arms pan, respectively. OD did not require a separate, long-term emission factor. Because of the large numberof OD treatment items containing lead, the short-term emission factor was also used to calculate ambient concentrations for the quarterly and annual exposure periods.

OB and OD emission factors were used in conjunction with dispersion modeling results for PP, SA, and OD to calculate ambient concentrations for all exposure periods. The procedure used to calculate ambient concentrations resulting from PP, SA, and OD is discussed in Section E-2-4c(6).

E-2-4b(3) Wind Erosion Emission Factors

In the case of the wind erosion pathway scenario, soil sampling data from the EOD soil sampling program were used to develop emission factors for all chemicals of concern identified in Table E-2-2. Soil sampling data for the 4-year period 1992 through 1995 were tabulated to determine the 95 percent Upper Confidence Level (UCL) concentration value for each chemical. The calculated 95 UCL for each chemical is shown in Table E-2-7. These UCL values were used in conjunction with the results of the wind erosion modeling analysis to calculate ambient concentrations for all applicable exposure periods. The procedure used to calculate ambient concentration resulting from wind erosion is discussed below in Section E-2-4c(6).

E-2-4c Dispersion Modeling Protocol

The air quality modeling analysis was conducted using a specific protocol. The objective of the protocol is to assess the ambient impact of OB and OD treatment operations at NWS Earle. The assessment also determines the impact from the wind erosion resuspension of particulate matter from the OD treatment area. The dispersion modeling analysis was conducted in accordance with the following standard U.S. EPA dispersion modeling guidance:

- Guidance on Air Quality Models (Revised U.S. EPA, 1987, 1990, 1994)
- Screening Procedures for Estimating the Air Quality Impact of Stationary Sources (U.S. EPA, 1992)
- INPUFF 2.3 - A Multiple Source Gaussian Puff Dispersion Algorithm User's Guide (U.S. EPA, 1986)
- User's Guide for the Fugitive Dust Model (FDM) (Revised U.S. EPA, January, 1991)

The following Sections E-2-4c(1) through E-2-4c(6) present a detailed discussion of modeling-protocol issues related to methodology, assumptions, receptor locations, source-release scenarios, meteorological data, air quality models, contaminant concentration calculations, modeling assumptions, and the protocol for conducting the risk assessment.

E-2-4c(1) Modeling Methodology and Assumptions

The air dispersion modeling analysis performed in this assessment can be classified as a screening analysis because it replicates the screening procedure outlined in U.S. EPA modeling guidance for estimating the air quality impact of stationary sources. The results of the analysis are considered to represent "worst case" ambient

TABLE E-2-7

LIST OF CHEMICALS OF CONCERN AND CORRESPONDING 95% UCL IN EOD SOIL CONCENTRATIONS FOR THE WIND EROSION SCENARIO NAVAL WEAPONS STATION EARLE

Chemicals Of Concern	95% Upper Confidence Level (mg/kg)
Organic Constituent	
2,4-Dinitrotoluene	0.0471
Inorganic Constituent	
Arsenic	4.4886
Barium	9.6688
Beryllium	0.6802
Cadmium	0.9128
Copper	7.9821
Lead	25.5652 <100-0Y
Mercury	0.1481
Nickel	3.0284
Selenium	0.4704
Zinc	16.7300

impacts because of the conservative nature of a screening analysis and the assumption of source parameters that favor the calculation of conservatively higher ambient concentrations.

The modeling analysis performed for each treatment unit (PP, SA, and OD) and the wind erosion scenario were completed in a similar sequential manner with slight variations or assumptions that were uniquely characteristic to each source. Because of the varying nature of OB and OD treatment processes and the wind erosion of particulate matter, it was necessary to develop separate protocols for each source of emissions.

The objective of each dispersion modeling analysis was to identify the worst-case meteorological conditions for each source of emissions, the maximum impact receptor locations, and associated ambient concentrations. Worst-case meteorological conditions for each source were identified from a matrix of wind speed categories and atmospheric stability conditions discussed below in Section E-2-4c(4).

Each combination of wind speed and stability class was modeled for each source to calculate a 1-hour air dispersion factor (ADF). The ADF is defined as the unit concentration associated with a specific unit emission rate. It is commonly referred to as "chi/q" with units of either $\mu g/m^3$-g/sec or $\mu g/m^3$-lb/hr. In the case of the PP, SA, and OD treatment units, the unit emission rate is 1.0 lb of emissions per hour. For the wind erosion scenario, the unit emission rate is the particulate wind erosion emission rate for each wind speed category. A maximum 1-hour ADF was then identified for each receptor network. Maximum 1-hour concentrations were extrapolated to obtain air dispersion factors for longer averaging periods using U.S. EPA scaling factors. Adjustments were then made to the ADF to account for the actual period of release. The ambient concentrations for each averaging period were subsequently used in the risk assessment analysis.

E-2-4c(2) Receptor Networks

Receptor Locations

A review of local topography in the vicinity of the NWS Earle indicates that the terrain is relatively flat and exhibits only minor differences in elevation. As a result, all receptors were assumed to be located in simple terrain.

Two separate receptor networks were used for the air dispersion modeling analysis and included NWS Earle site boundary receptors and discrete sensitive receptors that are accessible to the general public. Public access to the NWS Earle is restricted. Onsite receptors locations were not addressed in this analysis. The boundary and sensitive receptor networks are listed, respectively, in Tables E-2-8 and E-2-9 and are shown graphically in Figures E-2-4 and E-2-5. Model calculations were made to all receptors located along a single prevailing wind direction at the distances given in Tables E-2-8 and E-2-9.

A network of 74 boundary receptors was used for the portion of the NWS Earle site boundary that is located within a 10,000-foot radius of the Explosive Ordnance Demolition (EOD) range. These receptors are located at 200-meter intervals along the northern, eastern, and southern boundary of the site. Because the OB and OD treatment units are located within a short distance of each other and are at the same topographic elevation, a common origin has been assumed for both treatment sites.

A total of 12 discrete sensitive receptors were used for the sensitive receptor network. These receptors are located at various directions and distances from the EOD range and are composed of public schools, residential communities, and one nature area. The closest offsite residential receptor is located 914 meters north-northeast of the EOD range.

Reception elevation was not expected to significantly affect the results of the dispersion model calculations because there are no significant terrain features within the vicinity of the NWS Earle. The boundary receptors located nearest to the EOD range have elevations that are at or slightly below the EOD range elevation. A majority of the boundary and discrete sensitive receptors shown in Tables E-2-8 and E-2-9 have elevations that are

TABLE E-2-8

NORTHERN, EASTERN, AND SOUTHERN BOUNDARY RECEPTOR NETWORKS
NAVAL WEAPONS STATION EARLE

Northern Receptors			Eastern Receptors			Southern Receptors		
Receptor (meters)	Distance (meters)	Elevation MSL (meters)	Receptor (meters)	Distance (meters)	Elevation MSL (meters)	Receptor (meters)	Distance (meters)	Elevation MSL (meters)
North 1	3048	24	East 1	3239	43	South 1	2324	38
North 2	2819	24	East 2	3162	43	South 2	2362	38
North 3	2705	24	East 3	3048	43	South 3	2172	38
North 4	2591	24	East 4	2896	43	South 4	2134	38
North 5	2591	24	East 5	2781	42	South 5	1981	37
North 6	2458	24	East 6	2705	37	South 6	1791	37
North 7	2324	24	East 7	2591	43	South 7	1753	52
North 8	2134	24	East 8	2515	43	South 8	1753	55
North 9	1981	24	East 9	2477	43	South 9	1600	50
North 10	1867	24	East 10	2438	42	South 10	1410	38
North 11	1715	24	East 11	2438	43	South 11	1257	40
North 12	1524	24	East 12	2441	43	South 12	1143	37
North 13	1372	24	East 13	2442	43	South 13	991	37
North 14	1181	24	East 14	2477	43	South 14	800	34
North 15	991	24				South 15	991	35
North 16	838	24				South 16	1219	37
North 17	762	24				South 17	1410	40
North 18	724	24				South 18	1638	37
North 19	876	24				South 19	1829	35
North 20	1143	23				South 20	2057	35
North 21	1334	21				South 21	2286	35
North 22	1524	20				South 22	2477	34
North 23	1753	18				South 23	2705	34
North 24	1943	21				South 24	2858	34
North 25	2134	24				South 25	3048	32
North 26	2286	24						
North 27	2438	30						
North 28	2477	34						
North 29	2553	34						
North 30	2629	30						
North 31	2743	37						
North 32	2858	37						
North 33	2972	38						
North 34	3124	41						
North 35	3315	42						

MSL = Mean Sea Level

TABLE E-2-9

SENSITIVE RECEPTOR NETWORK
NAVAL WEAPONS STATION EARLE

Receptor Number	Discrete Receptor	Radial Distance (meters)	Elevation (MSL)
1	Shacks Corner (SW of NWS Earle)	7849	34
2	Howell School (SW of NWS Earle)	10211	23
3	Freehold School (W of NWS Earle)	7772	43
4	Colts Neck Township School (NW of NWS Earle)	5029	27
5	Closest Offsite Residential Receptor (NNE of OD)	914	26
6	Tinton Falls School (NNE of NWS Earle)	4420	15
7	Swimming River Natural Area (NNE of NWS Earle)	6706	12
8	Vetters School (NE of NWS Earle)	5791	12
9	Wayside (E of NWS Earle)	4267	37
10	Dogs Corner School (E of NWS Earle)	7544	18
11	Green Grove School (SE of NWS Earle)	5944	34
12	Hurley School (SE of NWS Earle)	6401	37

MSL = Mean Sea Level

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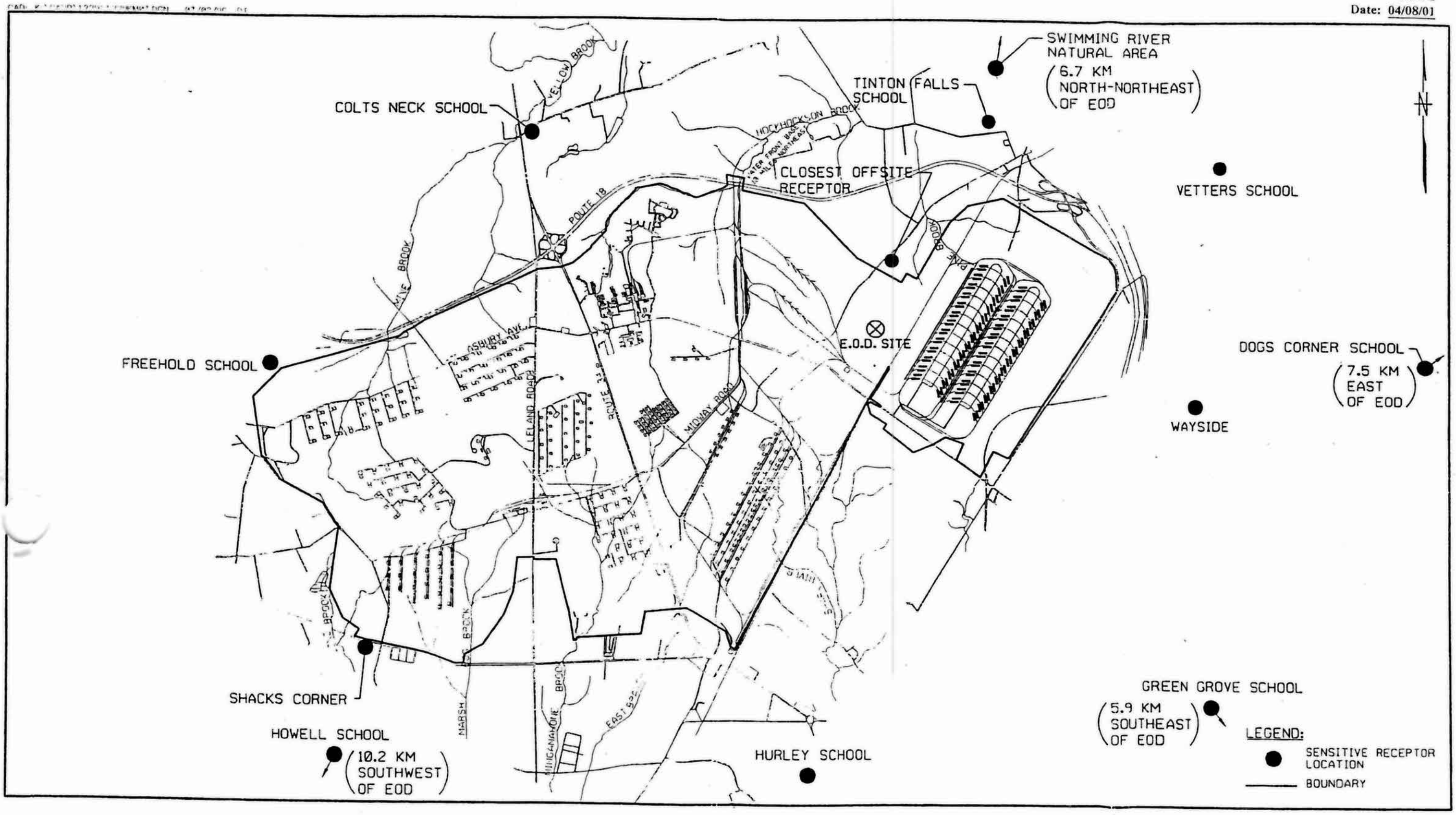


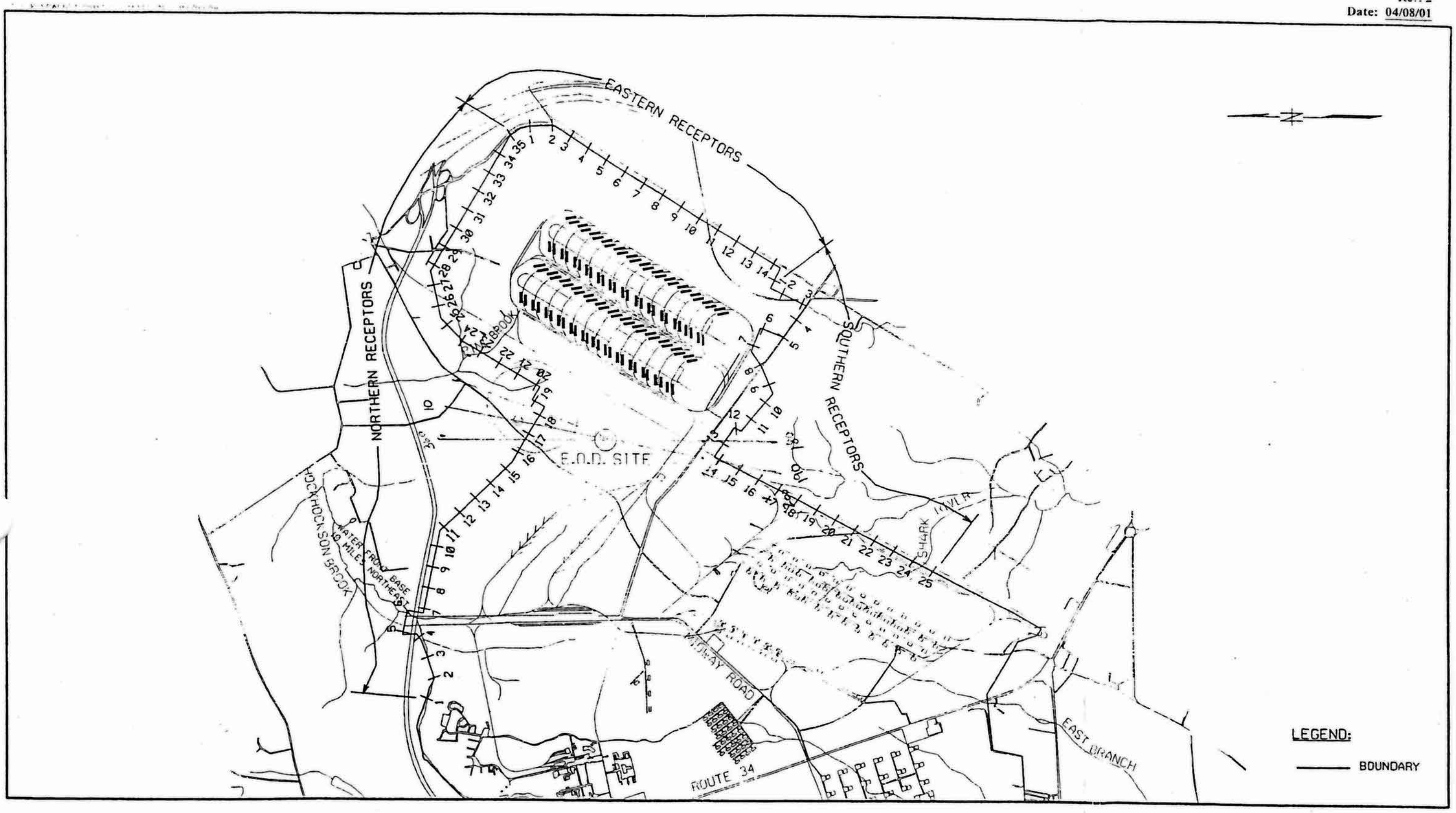
FIGURE E-2-5

SENSITIVE RECEPTOR LOCATIONS
NAVAL WEAPON STATION EARLE
COLTS NECK, NJ

0 4000 8000
SCALE IN FEET

Brown & Root Environmental

Date: 04/08/01



BOUNDARY RECEPTOR LOCATIONS
NAVAL WEAPON STATION EARLE
COLTS NECK, NJ

0 3000 6000
SCALE IN FEET

FIGURE E-2-4

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within a few meters of the EOD range elevation. The receptors having the greatest difference in elevation from the EOD range are located between 1,600 and 1,753 meters from the EOD range along the south boundary and are expected to be well beyond the point of maximum impact for each treatment unit.

E-2-4c(3) Source-Release Scenarios

OB Treatment

OB treatment is conducted at the propellant pan and small arms pan units at NWS Earle. Air releases from these OB operations can be characterized as both semi-instantaneous and short-term in nature. The emission-release scenarios for OB at the propellant and small arms pans are typically 10 seconds or 15 minutes, respectively. These emission-release periods were used in the dispersion modeling analysis for OB treatment.

The source-release parameters for OB at the propellant and small arms pans are given in Table E-2-10. All OB treatment was modeled as a buoyant point source with a 1-meter release height. The stack diameter dimensions for OB were obtained from the treatment containment devices (i.e., burn pan).

It is important to note that directly measured source-release data for OB temperature and exit velocity at the propellant pans and small arms pan are not available. As a result, it was necessary to develop methodologies to estimate these parameters to provide input to the dispersion models.

The propellant pan source temperature was obtained from the average POLU-11 combustion temperature data for all materials treated. The POLU-11 model was developed by the U.S. Navy to estimate air emissions and combustion parameters from energetic materials at OB/OD operations (Baroody and Tominack, 1987).

The source temperature for the small arms pan was determined in a dispersion modeling sensitivity analysis. In the sensitivity analysis, all source parameters, with the exception of source temperature, remained constant. Only the source temperature was adjusted until the calculated final plume height matched the observed final plume height (March 1994 field study) for the small arms pan. The analysis used the prevailing meteorological conditions at the time of the observation to calculate the final plume rise. The source temperature that replicated the observed plume height was used in subsequent modeling runs for the small arms pan treatment unit.

For the propellant pan, the OB source velocity was assumed to be 1.0 m/sec. For the small arms pans, the source velocity was assumed to be 0.5 m/sec. The exit velocities used for the OB treatment units are considered to be conservatively low, based on the nature of the OB combustion process and plume measurement data collected at other thermal treatment sites. The OB of propellants is typically characterized by a vigorous release of flame and hot gases and does not require auxiliary fuels.

OD Treatment

Air releases from OD operations can be characterized as intermittent and instantaneous. The source parameters for OD are provided in Table E-2-10. In the absence of source parameter test data, the exit velocity was set at 1.5 meters/second. This is considered to be a conservatively low estimate because OD is characterized by a sudden release of energy which results in a rapid expansion of the OD plume at detonation.

The diameter of the source release from OD was set at 1.0 meter and is based on OD crater observations. The emission release period for each OD simulation was 1 second.

Open detonation at NWS Earle is conducted either as a surface or subsurface event, depending on the NEW treatment quantity. Treatment quantities greater than 5 lbs NEW per pit require subsurface detonation. Open detonation final plume heights for surface and subsurface treatment were observed in a March 1994 field study. Results of the study indicated that the final plume height for subsurface detonation events are lower than the final plume height for surface detonations.

The open detonation source temperature was calculated in a sensitivity analysis using observed open detonation plume height data. The sensitivity study was conducted using the OD source parameters in Table E-2-10 and the observed subsurface final plume height as the target plume height value. The lower, subsurface plume height was selected because it is expected to result in conservatively higher concentrations for this analysis. The analysis was conducted in the same manner as described for open burning with the exception of the source-term parameters. The source temperature that replicated the observed subsurface final plume height was used in subsequent modeling runs for the open detonation treatment.

Wind Erosion (Particulate Resuspension)

The source-release parameters used for the wind erosion resuspension analysis are listed in Table E-2-11. Because wind erosion is a function of surface layer wind speed, a resuspension emission rate was calculated for each wind speed category identified below in the discussion on meteorological data. The resuspension emission rate for particulates was calculated using the methodology described in U.S. EPA publication, "Rapid Assessment of Exposure to Particulate Emission from Surface Contamination Sites" (1985). This assessment procedure categorizes sources as having either a "limited" or "unlimited" potential for particulate emissions from wind erosion. The unlimited erosion potential is defined as a surface that has little or no vegetative cover and lacks crusting of the top soil cover. Site visits to the OD treatment area show the location to be devoid of vegetation and contains medium- to fine-grade sand. These two factors result in the classification of the surface soil at the EOD site as having a high potential for erodibility. Therefore, the unlimited potential methodology was used to calculate resuspension emission rates for this site.

The soil at the EOD site is mostly medium to fine sand. Soil science reference data indicates that this soil typically exhibits particle diameters in the range of 50 to 400 microns. Reference data from four independent soil classifications estimate the lower range of particle size for medium to fine sand to be between 50 and 75 microns. The average for all four classifications is 65 microns. This average particle size was used as the "modal diameter" in the wind erosion emission rate calculation. The wind erosion analysis focused on the particle size range most susceptible to wind erosion. In lieu of site-specific soil densities, the analysis used a default soil density of 2.0 g/cm^3.

Specific information on potential OD surface soil contaminants was obtained from recent surface soil sampling at NWS Earle. Surface soil samples were collected from the EOD site and analyzed for certain explosives and metals. The 95 percent Upper Confidence Level (UCL) of concentration for each metal and explosive material analyzed in soil was used to calculate an ambient concentration for each applicable contaminant.

E-2-4c(4) Meteorological Data

Meteorological Data

The dispersion modeling analysis for OB and OD operations employed a screening level database of meteorological conditions to calculate maximum 1-hour ADFs. The databases are composed of a matrix of stability class and wind speed categories that are expected to provide an estimate of the "worst case" impact and also represent the range of permissible meteorological conditions for conducting OB and OD treatment at NWS Earle. The modeling analysis evaluated each combination of stability class and wind speed at each treatment unit (PP, SA, and OD) as well as the particulate resuspension analysis at the OD area.

The matrix of stability class and wind speed categories that were used for determining the worst-case impact from OB and OD is presented below:

Stability Class	Wind Speed Category (m/sec)
A	1.3, 3.0
B	1.3, 3.0, 5.0
C	1.3, 3.0, 5.0, 6.7
D	1.3, 3.0, 5.0, 6.7

TABLE E-2-10

INPUFF MODEL INPUT PARAMETERS FOR OB AND OD NAVAL WEAPONS STATION EARLE

Parameter	OB		OD
	Propellant Pan	Small Arms Pan	Open Detonation
Source Type	Point	Point	Point
Source Height (m)	1.0	1.0	1.0
Source Diameter (m)	3.00	2.00	1.00
Source Velocity (m/sec)	1	0.5	1.5
Source Temperature (°K)	*	**	**
Ambient Temperature (°K)	285	285	285
Source Elevation (ft)	90	90	90
Dispersion Option	Pasquill-Gifford	Pasquill-Gifford	Pasquill-Gifford
Downwash Option	No	No	No
Buoyancy-Induced Dispersion	Yes	Yes	Yes
Release Duration	10 sec	15 min	1 second
Mixing Height (m)	3,000	3,000	3,000

* Exit temperature was chosen from the POLU-11 combustion products model results.

** Exit temperature was determined in a sensitivity analysis that replicated final plume heights observed in a March 1994 field study, conducted by Brown & Root Environmental.

TABLE E-2-11

FDM SOURCE INPUT PARAMETERS FOR THE EOD SITE WIND EROSION RESUSPENSION ANALYSIS NAVAL WEAPONS STATION EARLE

Meteorological Data	Specific FDM Input Data
Emission rate	Wind speed specific
Particle density	2.0 g/cm^3 (assumed)
Modal diameter	65 microns
Source type/side dimension	Area/122 meters
Number of sources	1
Number of receptors	86 (Boundary and discrete)
Anemometer height	6.1 meters
Surface roughness length	1 cm

The wind speed range of 1.3 to 6.7 m/sec corresponds to the permissible wind speed conditions for OB and OD treatment as specified in Navy regulation NAVSEA OP-5. In addition, treatment is limited to 1-hour after sunrise to 1-hour before sunrise to limit OB/OD operation to stable/neutral atmospheric conditions. Treatment operations were modeled for each case of stability class and wind speed for a 1-hour period or 2-hour period so that the entire treatment plume passed the receptor location. The most distance receptors (> 6 km) required a 2-hour modeling period for the lowest wind speed category (1.3 m/sec) in order for the treatment plume to completely pass by the receptor. Meteorological conditions remained constant throughout the entire modeling period.

In the case of the particulate resuspension modeling for the OD treatment area, a slightly different matrix of stability class and wind speed categories was used. The matrix is intended to represent those meteorological conditions which are most conducive to the resuspension of particulate material via wind erosion. The matrix of stability class and wind speed categories used for the particulate resuspension modeling analysis is given below:

Stability Class	Wind Speed Category (m/sec)
A	3.0, 5.0
B	3.0, 5.0
C	3.0, 5.0, 6.7, 10, 15
D	3.0, 5.0, 6.7, 10, 15
E	3.0, 5.0
F	3.0, 5.0

E-2-4c(5) Air Quality Models

Two air quality dispersion models were used to simulate the release and transport of emissions from the OB and OD treatment operations and the resuspension of particulate matter from the OD treatment area. Further information on the specific use of each model is discussed below.

INPUFF Model

The INPUFF dispersion model was used to simulate the OB and OD treatment operations using the source-release parameters listed in Table E-2-10. The INPUFF model simulates dispersion from semi-instantaneous or continuous point sources over a spatially and temporally variable wind field. The dispersion modeling approach is based on Gaussian puff assumptions. Plume rise in the model is based on the standard Briggs equations for continuous sources.

Short-term dispersion is based either on the use of standard Pasquill-Gifford dispersion factors or onsite meteorological data. Because onsite meteorological data were not available for NWS Earle, the Pasquill-Gifford dispersion factors were used in this assessment. The INPUFF model was used to calculate 1-hour unit emission rate (1 lb/hr) dispersion factors for each meteorological condition in the matrix of wind speed and stability class described in Section E-2-4c(4). Wind direction remained invariant along the receptor direction during the entire 1-hour calculation period.

Fugitive Dust Model (FDM)

The FDM is a computerized air quality model specifically designed for computing concentration impacts from fugitive dust sources in simple terrain. The source may be defined as a point, area or line. The model computes a receptor concentration for the five line integration, then repeats the process for divisions with increasingly more lines until the results from successive integration are less than 1 percent different from the previous integration. FDM is designed to work with either preprocessed meteorological data or hourly surface data converted into a STability ARray format (STAR). Concentrations are computed at all user-selected receptor locations.

Emission rates (g/sec) for the OD resuspension analysis are a function of wind speed and are based on land characteristics such as square area of the OD area and surface cover (soil and vegetation) characteristics.

E-2-4c(6) Ambient Concentration Calculations

One-hour air dispersion factors (ADFs), referred to as chi/q, for each treatment unit and the wind erosion scenario were extrapolated to longer averaging periods (3-hour, 8-hour, 24-hour, quarterly, and annual) using conversion coefficients that take into account the frequency distribution of the wind direction and the number of hours of emission during the averaging period. These various averaging period ADF's were then used to estimate the concentration at the closest offsite sensitive and boundary receptors. The methodology used to calculate ambient concentration beyond the 1-hour averaging period is described below.

Wind Frequency Distribution Conversion Coefficients

Because emissions from the OB and OD treatment units occur for a short period (less than 1 hour), a wind frequency distribution coefficient was only applied to averaging periods greater than 3 hours, with the exception of the propellent pans and the small arms pans for 8- and 24-hour averaging periods. It was assumed that the wind direction could remain constant for at least a 3 hour period so no frequency adjustment was required. U.S. EPA screening analysis conversion factors for converting 1-hour concentrations to 8-hour ((0.7) and 24-hour (0.4) concentrations were used for the OB and OD sources. The wind frequency distribution conversion coefficient for converting 1-hour concentrations to quarterly and annual average concentrations was obtained from a wind rose analysis of meteorological data from the Newark, New Jersey, International Airport for the 5-year period 1988-1992. The maximum frequency distribution calculated for 16 wind directions for each of the 5 years was 0.11. The wind erosion scenario was assumed to represent a potentially continuous emitting source, so the U.S. EPA screening conversion coefficients were used as specified in the guidance document, with the exception of quarterly and annual which used the 0.11 conversion coefficient. The wind frequency conversion coefficients used for each treatment unit and the wind erosion scenario are summarized below.

	WIND FREQUENCY CONVERSION COEFFICIENTS					
SOURCE	1-HOUR	3-HOUR	8-HOUR	24-HOUR	QUARTERLY	ANNUAL
Propellant Pans	NA	NA	NA	NA	0.11	0.11
Small Arms Pans	NA	NA	NA	NA	0.11	0.11
Open Detonation	NA	NA	0.7	0.4	0.11	0.11
Wind Erosion	NA	0.9	0.7	0.4	0.11	0.11

Emission Period Conversion Coefficients

Due to the periodic nature of OB and OD emissions, it was necessary to extrapolate 1-hour concentrations to longer averaging periods on the basis of the number of hours that the treatment unit will be emitting during the averaging period. In this analysis, a quarter was assumed to represent 2,190 hours and one year was assumed to represent 8,760 hours.

For example, in the case of the propellant pans, one treatment event can be conducted in 1 hour and the pans will do no more than 2 treatment events per day. It was assumed that the propellant pans could do a maximum of 2 treatment events in 3 hours, 8 hours and 24 hours. For the quarterly and annual averaging periods, the propellant pans were assumed to conduct 24 and 96 days of treatment, respectively.

At the small arms pan, the maximum number of treatment events per day is one (1). Therefore, the emission period for the small arms pan over 3, 8, and 24 hours is one. For the quarterly and annual averaging periods, the small arms pan was assumed to conduct a maximum of 12 and 48 days of treatment, respectively.

The OD treatment unit can conduct a maximum of 7 treatment events per day. It was assumed that the OD treatment unit could do a maximum of 3 events over 3 hours, and 7 events over 8 and 24 hours. For the quarterly and annual averaging periods, the OD treatment unit was assumed to conduct a maximum of 65 and 260 days of treatment, respectively.

Because the wind erosion scenario was assumed to be a potentially continuous emitting source, no emission period conversion coefficients were utilized. The emission period conversion coefficients for each treatment unit are summarized below.

EMISSION PERIOD CONVERSION COEFFICIENTS						
SOURCE	1-HOUR	3-HOUR	8-HOUR	24-HOUR	QUARTERLY	ANNUAL
Propellant Pans	NA	2/3	2/8	2/24	(2x24)/2,190	(2x96)/8,760
Small Arms Pans	NA	1/3	1/8	1/24	(1x12)/2,190	(1x48)/8,760
Open Detonation	NA	3/3	7/8	7/24	(7x65)/2,190	(7x260)/8,760
Wind Erosion	NA	NA	NA	NA	NA	NA

3 hour = (1 hr ADF) * (treatment events per day) / (hours in averaging period)
8 hour = (1 hr ADF) * (treatment events per day) / (hours in averaging period) * wind frequency conversion coefficients
24 hour = (1 hr ADF) * (treatment events per day) / (hours in averaging period) * wind frequency conversion coefficients
Quarterly = (1 hr. ADF) * (treatment events per day) * (treatment days per quarter) / (hours in averaging period) * wind frequency conversion coefficients
Annual = (1 hr. ADF) * (treatment events per day) * (treatment days per year) / (hours in averaging period) * wind frequency conversion coefficients

The equations used to calculate ambient concentrations for averaging periods greater than 1 hour for each treatment unit and wind erosion are shown below.

Propellant Pans

Air Dispersion Factor

1-hr to 3-hr = (1-hr ADF) x (2/3)
1-hr to 8-hr = (1-hr ADF) x (2/8)
1-hr to 24-hr = (1-hr ADF) x (2/24)
1-hr to quarterly = (1-hr ADF) x [(2x24)/2,190] x 0.11
1-hr to annual = (1-hr ADF) x [(2x96)/8,760] x 0.11

Small Arms Pans

1-hr to 3-hr = (1-hr ADF) x (1/3)
1-hr to 8-hr = (1-hr ADF) x (1/8)
1-hr to 24-hr = (1-hr ADF) x (1/24)
1-hr to quarterly = (1-hr ADF) x [(1x12)/2,190] x 0.11
1-hr to annual = (1-hr ADF) x [(1x48)/8,760] x 0.11

Open Detonation

1-hr to 3-hr = (1-hr ADF) x (3/3)
1-hr to 8-hr = (1-hr ADF) x (7/8) x 0.7
1-hr to 24-hr = (1-hr ADF) x (7/24) x 0.4
1-hr to quarterly = (1-hr ADF) x [(7x65)/2,190] x 0.11
1-hr to annual = (1-hr ADF) x [(7x260)/8,760] x 0.11

Wind Erosion

1-hr to 3-hr = (1-hr ADF) x 0.9
1-hr to 8-hr = (1-hr ADF) x 0.7
1-hr to 24-hr = (1-hr ADF) x 0.4
1-hr to quarterly = (1-hr ADF) x 0.11
1-hr to annual = (1-hr ADF) x 0.11

E-2-4c(7) Background Concentrations

In addition to calculating the ambient impact from individual treatment units and the wind erosion scenario, the cumulative impact of all sources were determined for each applicable averaging period to get a cumulative impact for comparison with New Jersey and National air quality standards. The comparison to New Jersey and National air quality standards included the contribution from background air quality.

For this analysis, the second highest criteria pollutant ambient concentrations reported in Table E-2-1 were used as representative concentrations for background air quality. These concentrations were added to the cumulative impact of all Earle OB/OD treatments units and the wind erosion scenario to determine compliance with New Jersey and National air quality standards.

E-2-4d Dispersion Modeling Results

The air dispersion modeling was conducted in accordance with the procedures described in Section E-2-4c. Appendix E-2-3 contains a summary of air dispersion factors for all boundary and sensitive receptors for each emission unit (propellant pan, small arms pan, open detonation and wind erosion). Appendix E-2-4 contains all air dispersion modeling input/output files, air dispersion factors, ground level concentrations, risk, and hazard spread sheets in electronic format.

The maximum ADFs for the boundary and sensitive receptor networks were calculated to be at the "North 18" and "Closest Offsite" receptors, respectively. Table E-2-12 contains a summary listing of the North 18 and Closest Offsite maximum 1-hour ADFs and associated meteorological conditions resulting from the modeling analysis. Table E-2-13 contains a summary of the ADFs for each averaging period (1-hour, 3-hour, 8-hour, 24-hour, quarterly, and annual) used to calculate the air concentrations for the risk assessment according to the discussion on ambient concentration calculations found in Section E-2-4c(6).

E-2-5 RISK ASSESSMENT

The risk assessment conducted for this application followed the guidelines contained in the Technical Manual 1003: Air Quality Regulation Program Bureau of Air Quality Evaluation Guidance on Preparing a Risk Assessment Protocol for Air Contaminant Emissions, NJDEP, 1994. This guidance document divides the risk assessment process into 4 steps.

1. Hazard Identification
2. Dose-Response Assessment
3. Exposure Assessment
4. Risk Characterization

TABLE E-2-12

SUMMARY OF MAXIMUM 1-HOUR AIR DISPERSION FACTORS FOR THE NORTH 18 AND CLOSEST OFFSITE RECEPTORS NAVAL WEAPONS STATION EARLE

Receptor	Location Name	Meteorology	1-Hour ADF (CHI/Q)
Propellant Pan Sensitive	Closest Offsite Resident	C Stability 1.3 m/sec	1.69E+0
Propellant Pan Boundary	North 18	B Stability 1.3 m/sec	1.58E+0
Small Arms Sensitive	Closest Offsite Resident	D Stability 1.3 m/sec	1.56E+1
Small Arms Boundary	North 18	D Stability 1.3 m/sec	2.27E+1
OD Actual Sensitive	Closest Offsite Resident	D Stability 1.3 m/sec	1.55E+1
OD Boundary	North 18	D Stability 1.3 m/sec	2.24E+1
Wind Erosion Sensitive	Closest Offsite Resident	D Stability 15.0 m/sec	3.05E+1
Wind Erosion Boundary	North 18	D Stability 15.0 m/sec	5.02E+1

TABLE E-2-13

SUMMARY OF AIR DISPERSION FACTORS (µg/m^3-lb) FOR ALL AVERAGING PERIODS AT THE MAXIMUM BOUNDARY AND SENSITIVE RECEPTOR LOCATIONS NAVAL WEAPONS STATION EARLE

Unit	1 Hour		3 Hour		8 Hour		24 Hour		Quarterly		Annual	
	Sensitive	Boundary	Sensitive	Boundary	Sensitive	Boundary	Sensitive	Boundary	Sensitive	Boundary	Sensitive	Boundary
Propellant Pan	1.69E+00	1.58E+00	1.13E-00	1.05E-00	4.23E-01	3.95E-01	1.41E-01	1.32E-01	4.07E-03	3.81E-03	4.07E-03	3.81E-03
Small Arms Pan	1.56E+01	2.27E+01	5.20E+00	7.57E+00	1.95E+00	2.84E+00	6.50E-01	9.46E-01	9.40E-03	1.37E-02	9.40E-03	9.40E-03
Open Detonation	1.55E+01	2.24E+01	1.55E+01	2.24E+01	9.49E+00	1.37E+01	1.81E-00	2.61E-00	3.54E-01	5.12E-01	3.54E-01	5.12E-01
Wind Erosion	3.05E+01	5.02E+01	2.75E+01	4.52E+01	2.14E+01	3.51E+01	1.22E+01	2.01E+01	3.36E+00	5.52E+00	3.36E+00	5.52E+00

The following subsections discuss each of these steps and present the results of the assessment in terms of risk and hazard for each individual treatment unit (PP, SA, and OD) and the wind erosion scenario at NWS Earle. In addition, air quality impacts for individual treatment units and the wind erosion scenario are compared to applicable NAAQS and NJAQS.

E-2-5a Risk Assessment Protocol

Each step used to conduct the NWS Earle risk assessment for the OB/OD treatment units and the wind erosion scenario are present below. The results of the risk assessment are discussed in Section E-2-5b.

Hazard Identification

The initial step of the risk assessment involved the identification of all contaminants emitted during treatment operations. This list of potential chemicals (Table E-2-2) of concern for each treatment unit and the wind erosion scenario were reviewed for contaminants with known health effects.

The identification of the contaminants emitted is based on the constituent makeup of the munitions being treated at NWS Earle and data from tests of OB/OD emissions conducted at the Dugway Proving Grounds. In general, there are two types of emissions from open burning and open detonation operations. These are constituents (chemicals present in the munitions item which are not completely combusted in the treatment process) and PICs, which are chemicals not originally found in the item being treated, but are formed during the treatment process as a result of incomplete combustion of the item. Constituents may include energetic material (such as 2,4-dinitrotoluene) or metals (such as barium or antimony). PICs may include such semivolatile organics as benzo[a]pyrene and 1,3-butadiene, as well as other organic and inorganic species including benzene and ammonia. All emissions of PICs are based on the Dugway data. Section E-2-4b describes the process used to identify chemicals for the emissions. Table E-2-2 lists the potential chemicals of concern for each treatment unit and wind erosion.

The list of potential chemicals of concern was then screened for contaminants with known health effects. Appendix A of Technical Manual 1003 was used to identify the contaminants with health effects (Table E-2-3). In addition, all contaminants having NAAQS and NJAQS were identified. These chemicals of concern for which risks and hazards will be determined were selected as the focus of the risk assessment.

Dose-Response Assessment

Once the chemicals of concern were identified, unit risk factors (URFs) were used for each carcinogen to estimate risk and inhalation reference concentrations (RfCs) to estimate the noncarcinogenic effects of inhalation. Appendix A of Technical Manual 1003 contains BAQEv's listing of URFs and RfCs used in this risk assessment. In addition, a list of NAAQS for the criteria pollutants and all relevant NJAQS were identified.

Exposure Assessment

The third step of the risk assessment process involved determining the intensity, frequency, and duration of human exposure to chemicals emitted during each treatment process (PP, SA, and OD) or from the wind erosion resuspension of EOD surface soil. Variables and other information taken into account in this step included the following:

- The duration of the treatment process. Open burning and open detonation processes are typically of very short duration. In general, an open burning event lasts a few minutes, and an open detonation event a few seconds. Given that there are logistical limitations on the number of events that are possible in a 1-hour or 1-day period, it is not practical to assume that the operation is being carried out 24 hours per day, 365 days per year. In addition, limitations on operations imposed by the operating license or permit also affect the total amount of time that a receptor may be exposed to any contaminants emitted by these processes. Information regarding the duration of each treatment process is discussed in Section E-2-4c(3).

- The ambient air concentrations of each chemical of concern. The ambient air concentrations were determined for each averaging period based on the maximum quantities of potential emissions for each chemical of concern.

- Wind erosion process. The resuspension of particulate matter from the OD treatment area is assumed to begin when the surface layer wind-speed reaches a threshold level (assumed to be 3.0 meters/sec). Higher wind speed cases up to 15 m/sec were evaluated. Because the resuspension of particulate matter via wind erosion is a function of wind speed, separate resuspension emission rates were calculated for each wind speed category.

Risk Characterization

The final step of the risk assessment entailed the calculation of the carcinogenic risks and hazard quotients for each contaminant identified in the Hazard Identification step. The carcinogenic risks and hazard quotients for each contaminant were calculated separately from open burning (propellant and small arms), open detonation, and wind erosion units. Potential uncertainties regarding these assumptions and how they affect the risk calculations are discussed in the Uncertainty Analysis (Section E-2-6).

The risk assessment also contains an uncertainty analysis, which includes a discussion of each parameter or assumption (such as the process duration variables, discussed above), and the impact of these assumptions on the uncertainty of the overall assessment. The uncertainty analysis is discussed in Section E-2-6. Each chemical of concern that is emitted by the unit and that has a known health effect identified in Technical Manual 1003, NAAQS, or NJAQS has been addressed.

E-2-5b Risk Characterization

E-2-5b(1) OB Propellant Pan

The results of the risk characterization for OB propellant pan treatment are presented in Tables E-2-14 through E-2-16 for the worst case sensitive and boundary receptors. Table E-2-14 presents the carcinogenic risk. Table E-2-15 presents the hazard quotients, whereas Table E-2-16 shows a comparison of ambient impacts to applicable air quality standards for criteria pollutants.

E-2-5b(2) OB Small Arms Pan

The results of the risk characterization for OB small arms treatment are presented in Tables E-2-17 through E-2-19 for the maximum exposed sensitive and boundary receptor. Table E-2-17 presents the carcinogenic risk. Table E-2-18 presents the hazard quotients, whereas Table E-2-19 shows a comparison of ambient impacts to applicable air quality standards for criteria pollutants.

E-2-5b(3) OD

The results of the risk characterization for open detonation treatment for the maximum impacted sensitive and boundary receptor are presented in Tables E-2-20 through E-2-22. Table E-2-20 presents the carcinogenic risk. Table E-2-21 presents the hazard quotients, whereas Table E-2-22 shows a comparison of ambient impacts to applicable air quality standards for criteria pollutants.

E-2-5b(4) Wind Erosion

The results of the risk characterization for the wind erosion emission scenario, for the maximum exposed boundary and sensitive receptors, are presented in Tables E-2-23 through E-2-25. Table E-2-23 presents the carcinogenic

TABLE E-2-14

CALCULATED CANCER RISK FOR THE AIR PATHWAY FROM PROPELLANT PAN TREATMENT FOR THE MAXIMUM SENSITIVE AND BOUNDARY RECEPTOR LOCATIONS NAVAL WEAPONS STATION EARLE

Chemical	Averaging Period	Treatment Quantity (per event) (lbs NEW)	Averaging Period ADF ($\mu g/m^3$-lb)	Emission Factor (lb emitted per lb treated)	Air Concentration[1] ($\mu g/m^3$)	URF[2] $(\mu g/m^3)^{-1}$	Calculated Cancer Risk[3]
Closest Offsite Sensitive Recepor							
2,4-Dinitrotoluene	Annual	800	4.07E-03	3.20E-06	1.04E-05	8.90E-05	9.28E-10
Benzene	Annual	800	4.07E-03	5.60E-06	1.83E-05	8.30E-06	1.52E-10
Benzo(a)pyrene	Annual	800	4.07E-03	1.50E-07	4.89E-07	1.70E-03	8.31E-10
N-Nitrosodiphenylamine	Annual	800	4.07E-03	2.30E-07	7.50E-07	1.40E-06	1.05E-12
North18 Boundary Receptor							
2,4-Dinitrotoluene	Annual	800	3.81E-03	3.20E-06	9.75E-06	8.90E-05	8.68E-10
Benzene	Annual	800	3.81E-03	5.60E-06	1.71E-05	8.30E-06	1.42E-10
Benzo(a)pyrene	Annual	800	3.81E-03	1.50E-07	4.57E-07	1.70E-03	7.77E-10
N-Nitrosodiphenylamine	Annual	800	3.81E-03	2.30E-07	7.01E-07	1.40E-06	9.81E-13

1 Air Concentrations = (treatment quantity per event) x (averaging period ADF) x (Emission Factor)

2 Unit Risk Factors obtained from NJDEP Technical Manual 1003

3 Calculated Cancer Risk = Air Concentation ($\mu g/m^3$) x URF $(\mu g/m^3)^{-1}$

TABLE E-2-15

CALCULATED HAZARD QUOTIENT FOR THE AIR PATHWAY FROM PROPELLANT PAN TREATMENT FOR THE MAXIMUM SENSITIVE AND BOUNDARY RECEPTOR LOCATIONS NAVAL WEAPONS STATION EARLE

Chemical	Averaging Period	Treatment Quantity (per event) (lbs NEW)	Averaging Period ADF ($\mu g/m^3$-lb)	Emission Factor (lb emitted per lb treated)	Air Concentration[1] ($\mu g/m^3$)	RfC[2] ($\mu g/m^3$)	Hazard Quotient[3]
Closest Offsite Sensitive Receptor							
Ammonia	Annual	800	4.07E-03	2.00E-05	6.52E-05	1.00E+02	6.52E-07
Benzene	24-Hour	800	1.41E-01	9.68E-05	1.09E-02	1.90E+01	5.74E-04
Barium	Annual	800	4.07E-03	1.54E-03	5.02E-03	5.00E-01	1.00E-02
Copper	Annual	800	4.07E-03	5.53E-05	1.80E-04	1.30E-01	1.39E-03
Lead	24-Hour	800[a]	1.41E-01	b	1.00E+00[c]	1.00E-01	1.00E+01[d]
Phenol	Annual	800	4.07E-03	2.30E-06	7.50E-06	4.50E+01	1.67E-07
Zinc	Annual	800	4.07E-03	5.00E-06	1.63E-05	2.00E-01	8.15E-05
North 18 Boundary Receptor							
Ammonia	Annual	800	3.81E-03	2.00E-05	6.09E-05	1.00E+02	6.09E-07
Benzene	24-Hour	800	1.32E-01	9.68E-05	4.08E-03	1.90E+01	5.37E-04
Barium	Annual	800	3.81E-03	1.54E-03	4.69E-03	5.00E-01	9.39E-03
Copper	Annual	800	3.81E-03	5.53E-05	1.69E-04	1.30E-01	1.30E-03
Lead	24-Hour	800[a]	1.32E-01	b	9.40E-01[c]	1.00E-01	9.37E+00[e]
Phenol	Annual	800	3.81E-03	2.30E-06	7.01E-06	4.50E+01	1.56E-07
Zinc	Annual	800	3.81E-03	5.00E-06	1.52E-05	2.00E-01	7.62E-05

1 Air Concentrations = (treatment quantity) x (averaging period ADF) x (Emission Factor). In the case of lead, the maximum concentration = (7.1 pounds of lead) x (Averaging period ADF).
2 Reference concentration (RfC) obtained from NJDEP Technical Manual
3 Hazard Quotient = Air Concentration ($\mu g/m^3$) / (RfC ($\mu g/m^3$)
a In the case of lead containing items, the quantity of NEW treated over a 24-hour period cannot exceed 800 pounds and contain more than 7.1 pounds of lead.
b Because 24-hour emissions of lead are limited to 7.1 pounds, the emission factor term is not used to calculate the air concentration. See footnote 1.
c The air concentration is calculated on the basis of treating 7.1 pounds of lead per 24-hour period. See footnote 1.
d This is the maximum hazard quotient associated with limiting lead emissions to 7.1 pounds per day for 90 treatment days per year. For the remainng 6 treatment days per year lead emissions are limited to 0.7 pounds per day which results in a hazard quotient of 1.0.
e This is the maximum hazard quotient associated with limiting lead emissions to 7.1 pounds per day for 90 treatment days per year. For the remaining 150 treatment days per year lead emissions are limited to 0.7 pounds per day which results in a hazard quotient of 0.94.

TABLE E-2-16

A COMPARISON OF CRITERIA POLLUTANT AIR QUALITY STANDARDS TO IMPACTS FROM PROPELLANT PAN TREATMENT FOR THE MAXIMUM SENSITIVE AND BOUNDARY RECEPTOR LOCATIONS NAVAL WEAPONS STATION EARLE

Chemical	Averaging Period	Treatment Quantity per event (lbs NEW)	Emission Factors (lbs/lbs)	Averaging Period ADF ($\mu g/m^3$-lb)	Propellant Pan Maximum Concentration ($\mu g/m^3$)	Ambient Background Concentration ($\mu g/m^3$)	Total Impact ($\mu g/m^3$)	NJAAQS/NAAQS ($\mu g/m^3$)
Closest Offsite Sensitive Receptor								
Carbon Monoxide	1-hour	800	6.14E-04	1.69E+00	8.30E-01	12,315	12,315	40,000
Carbon Monoxide	8-hour	800	6.14E-04	2.96E-01	1.45E-01	7,436	7,436	10,000
Lead	Quarterly	800[a]	2.61E-02	4.07E-03	2.89E-02	0.05	0.08	1.5
Nitrogen Dioxide	Annual	800	7.50E-04	4.07E-03	2.44E-03	46	46	100
PM10	24-Hour	800	1.60E-02	1.41E-01	1.80E+00	51	53	150
PM10	Annual	800	1.10E-02	4.07E-03	3.59E-02	23	23	50
Sulfur Dioxide	3-hour	800	7.34E-04	1.13E+00	6.62E-01	112	112	1,300
Sulfur Dioxide	24-hour	800	7.34E-04	1.41E-01	8.27E-02	80	80	365
Sulfur Dioxide	Annual	800	2.50E-04	4.07E-03	8.15E-04	13	13	80
TSP	24-hour	800	1.60E-02	1.41E-01	1.80E+00	75	77	150
TSP	Annual	800	1.10E-02	4.07E-03	3.59E-02	22	22	75(P)
TSP	Annual	800	1.10E-02	4.07E-03	3.59E-02	22	22	60(S)
North 18 Boundary Receptor								
Carbon Monoxide	1-hour	800	6.14E-04	1.58E+00	7.76E-01	12,315	12,316	40,000
Carbon Monoxide	8-hour	800	6.14E-04	2.77E-01	1.36E-01	7,436	7,436	10,000
Lead	Quarterly	800[a]	2.61E-02	3.81E-03	2.71E-02	0.05	0.08	1.5
Nitrogen Dioxide	Annual	800	7.50E-04	3.81E-03	2.29E-03	46	46	100
PM10	24-Hour	800	1.60E-02	1.32E-01	1.69E+00	51	53	150
PM10	Annual	800	1.10E-02	3.81E-03	3.35E-02	23	23	50
Sulfur Dioxide	3-hour	800	7.34E-04	1.05E+00	6.19E-01	112	112	1,300
Sulfur Dioxide	24-hour	800	7.34E-04	1.32E-01	7.73E-02	80	80	365
Sulfur Dioxide	Annual	800	2.50E-04	3.81E-03	7.62E-04	13	13	80
TSP	24-hour	800	1.60E-02	1.32E-01	1.69E+00	75	77	150
TSP	Annual	800	1.10E-02	3.81E-03	3.35E-02	22	22	75(P)
TSP	Annual	800	1.10E-02	3.81E-03	3.35E-02	22	22	60(S)

Propellant Pans Maximum Concentration = Emission Factor * Treatment Quantity per event * Averaging Period ADF. In the case of lead, the maximum concentration = (7.1 pounds) x (Averaging Period ADF).
Total Impact = Ambient Background + Propellant Pan Maximum Concentration
(P) - New Jersey Primary Standard
(S) - New Jersey Secondary Standard
NJAAQS - New Jersey Ambient Air Quality Standards
NAAQS - National Ambient Air Quality Standards
a In the case of lead, the quarterly concentration is based on treating a maximum of 7.1 pounds of lead in a 24-hour period. The maximum number of treatments per quarter is 24.

TABLE E-2-17

CALCULATED CANCER RISK FOR THE AIR PATHWAY FROM SMALL ARMS TREATMENT FOR THE MAXIMUM SENSITIVE AND BOUNDARY RECEPTOR LOCATIONS NAVAL WEAPONS STATION EARLE

Chemical	Averaging Period	Treatment Quantity (per event) (lbs NEW)	Averaging Period ADF ($\mu g/m^3$-lb)	Emission Factor (lb emitted per lb treated)	Air Concentration[1] ($\mu g/m^3$)	URF[2] $(\mu g/m^3)^{-1}$	Calculated Cancer Risk[3]
Closest Offsite Sensitive Recepor							
2,4-Dinitrotoluene	Annual	50	4.70E-02	3.20E-06	7.52E-06	8.90E-05	6.69E-10
Benzene	Annual	50	4.70E-02	5.60E-06	1.32E-05	8.30E-06	1.09E-10
Benzo(a)pyrene	Annual	50	4.70E-02	1.50E-07	3.53E-07	1.70E-03	5.99E-10
N-Nitrosodiphenylamine	Annual	50	4.70E-02	2.30E-07	5.41E-07	1.40E-06	7.57E-13
North18 Boundary Receptor							
2,4-Dinitrotoluene	Annual	50	6.84E-02	3.20E-06	1.09E-05	8.90E-05	9.74E-10
Benzene	Annual	50	6.84E-02	5.60E-06	1.92E-05	8.30E-06	1.59E-10
Benzo(a)pyrene	Annual	50	6.84E-02	1.50E-07	5.13E-07	1.70E-03	8.72E-10
N-Nitrosodiphenylamine	Annual	50	6.84E-02	2.30E-07	7.87E-07	1.40E-06	1.10E-12

1 Air Concentrations = (treatment quality per event) x (Averaging Period ADF) x (Emission Factor)

2 Unit Risk Factors (URF) obtained from NJDEP Technical Manual 1003

3 Calculated Cancer Risk = Air Concentration ($\mu g/m^3$) x URF $(\mu g/m^3)^{-1}$

TABLE E-2-18

CALCULATED HAZARD QUOTIENT FOR THE AIR PATHWAY FROM SMALL ARMS TREATMENT FOR THE MAXIMUM SENSITIVE AND BOUNDARY RECEPTOR LOCATIONS NAVAL WEAPONS STATION EARLE

Chemical	Averaging Period	Treatment Quantity (per event) (lbs NEW)	Averaging Period ADF ($\mu g/m^3$-lb)	Emission Factor (lb emitted per lb treated)	Air Concentration[1] ($\mu g/m^3$)	RfC[2] ($\mu g/m^3$)	Hazard Quotient[3]
Closest Offsite Sensitive Receptor							
Ammonia	Annual	50	4.70E-02	2.00E-05	4.70E-05	1.00E+02	4.70E-07
Barium	Annual	50	4.70E-02	1.12E-04	2.63E-04	5.00E-01	5.27E-04
Benzene	24-Hour	50	6.50E-01	9.68E-05	3.15E-03	1.90E+01	1.66E-04
Lead	24-Hour	50[a]	6.50E-01	b	6.89E-01[c]	1.00E-01	6.89E+00[d]
Phenol	Annual	50	4.70E-02	2.30E-06	5.41E-06	4.50E+01	1.20E-07
Zinc	Annual	50	4.70E-02	7.70E-05	1.81E-04	2.00E-01	9.05E-04
North18 Boundary Receptor							
Ammonia	Annual	50	6.84E-02	2.00E-05	6.84E-05	1.00E+02	6.84E-07
Barium	Annual	50	6.84E-02	1.12E-04	3.83E-04	5.00E-01	7.66E-04
Benzene	24-Hour	50	9.46E-01	9.68E-05	4.58E-03	1.90E+01	2.41E-04
Lead	24-Hour	50[a]	9.46E-01	b	1.00E+00[c]	1.00E-01	1.00E+01[e]
Phenol	Annual	50	6.84E-02	2.30E-06	7.87E-06	4.50E+01	1.75E-07
Zinc	Annual	50	6.84E-02	7.70E-05	2.63E-04	2.00E-01	1.32E-03

1 Air Concentrations = (treatment quantity per event) x (Averaging Period ADF) x (Emission Factor). In the case of lead, the maximum concentration = (1.06 pounds) x (Averaging Period ADF).
2 Reference Concentration (RfC) obtained from NJDEP Technical Manual 1003.
3 Hazard Quotient = Air Concentration ($\mu g/m^3$) / (RfC ($\mu g/m^3$)
a In the case of lead containing items, the quantity of NEW treated over a 24-hour period cannot exceed 800 pounds and contain more than 1.06 pounds of lead.
b Because the 24-hour lead emissions are limited to 1.06 pounds, the emission factor is not used to calculate the air concentration. See footnote 1.
c The air concentration is calculated on the basis of treating 1.06 pounds of lead per 24-hour period. See footnote 1.
d This is the maximum hazard quotient associated with limiting lead emissions to 1.06 pounds per day for 90 treatment days per year. For the remaining 150 treatment days per year lead emissions are limited to 0.1 pounds per day which results in a hazard quotient of 0.68.
e This is the maximum hazard quotient associated with limiting lead emissions to 1.06 pounds per day for 90 treatment days per year. For the remaining 150 treatment days per year lead emissions are limited to 0.1 pounds per day which results in a hazard quotient of 1.0.

TABLE E-2-19

A COMPARISON OF CRITERIA POLLUTANT AIR QUALITY STANDARDS TO IMPACTS FROM SMALL ARMS TREATMENT FOR THE MAXIMUM SENSITIVE AND BOUNDARY RECEPTOR LOCATIONS NAVAL WEAPONS STATION EARLE

Chemical	Averaging Period	Treatment Quantity per event (lbs NEW)	Emission Factors (lbs/lbs)	Averaging Period ADF (μg/m³-lb)	Small Arms Pan Maximum Concentration (μg/m³)	Ambient Background Concentration (μg/m³)	Total Impact (μg/m³)	NJAAQS/NAAQS (μg/m³)
Closest Offsite Sensitive Receptor								
Carbon Monoxide	1-hour	50	6.14E-04	1.56E+01	4.79E-01	12,315	12,315	40,000
Carbon Monoxide	8-hour	50	6.14E-04	1.37E+00	4.19E-02	7,436	7,436	10,000
Lead	Quarterly	50[a]	2.61E-02	4.70E-02	5.00E-02	0.05	0.10	1.5
Nitrogen Dioxide	Annual	50	7.50E-04	4.70E-02	1.76E-03	46	46	100
PM10	24-Hour	50	1.60E-02	6.50E-01	5.20E-01	51	52	150
PM10	Annual	50	1.10E-02	4.70E-02	2.59E-02	23	23	50
Sulfur Dioxide	3-hour	50	7.34E-04	5.20E+00	1.91E-01	112	112	1,300
Sulfur Dioxide	24-hour	50	7.34E-04	6.50E-01	2.39E-02	80	80	365
Sulfur Dioxide	Annual	50	2.50E-04	4.70E-02	5.88E-04	13	13	80
TSP	24-hour	50	1.60E-02	6.50E-01	5.20E-01	75	76	150
TSP	Annual	50	1.10E-02	4.70E-02	2.59E-02	22	22	75(P)
TSP	Annual	50	1.10E-02	4.70E-02	2.59E-02	22	22	60(S)
North 18 Boundary Receptor								
Carbon Monoxide	1-hour	50	6.14E-04	2.27E+01	6.97E-01	12,315	12,316	40,000
Carbon Monoxide	8-hour	50	6.14E-04	1.99E+00	6.10E-02	7,436	7,436	10,000
Lead	Quarterly	50[a]	2.61E-02	6.84E-02	7.25E-02	0.05	0.12	1.5
Nitrogen Dioxide	Annual	50	7.50E-04	6.84E-02	2.57E-03	46	46	100
PM10	24-Hour	50	1.60E-02	9.46E-01	7.57E-01	51	52	150
PM10	Annual	50	1.10E-02	6.84E-02	3.76E-02	23	23	50
Sulfur Dioxide	3-hour	50	7.34E-04	7.57E+00	2.78E-01	112	112	1,300
Sulfur Dioxide	24-hour	50	7.34E-04	9.46E-01	3.47E-02	80	80	365
Sulfur Dioxide	Annual	50	2.50E-04	6.84E-02	8.55E-04	13	13	80
TSP	24-hour	50	1.60E-02	9.46E-01	7.57E-01	75	76	150
TSP	Annual	50	1.10E-02	6.84E-02	3.76E-02	22	22	75(P)
TSP	Annual	50	1.10E-02	6.84E-02	3.76E-02	22	22	60(S)

Small Arms Pan Maximum Concentration = (Emission Factor) x (Treatment Quantity per event) x (Averaging Period ADF). In the case of lead, the maximum concentration = (1.06 pounds) x (Averaging Period ADF).

Total Impact = Ambient Background Concentration + Small Arms Pan Maximum Concentration

(P) - New Jersey Primary Standard

(S) - New Jersey Secondary Standard

NJAAQS - New Jersey Ambient Air Quality Standards

NAAQS - National Ambient Air Quality Standards

a In the case of lead, the quarterly concentration is based on treating a maximum of 1.06 pounds of lead in a 24-hour period. The maximum number of treatments per quarter is 60.

TABLE E-2-20

CALCULATED CANCER RISK FOR THE AIR PATHWAY FROM OPEN DETONATION TREATMENT FOR THE MAXIMUM SENSITIVE AND BOUNDARY RECEPTOR LOCATIONS NAVAL WEAPONS STATION EARLE

Chemical	Averaging Period	Treatment Quantity (per event) (lbs NEW)	Averaging Period ADF ($\mu g/m^3$-lb)	Emission Factor (lb emitted per lb treated)	Air Concentration[1] ($\mu g/m^3$)	URF[2] $(\mu g/m^3)^{-1}$	Calculated Cancer Risk[3]
Closest Offsite Sensitive Receptor							
1,3-Butadiene	Annual	50	3.54E-01	6.56E-06	1.16E-04	2.80E-04	3.25E-08
2,4-Dinitrotoluene	Annual	50	3.54E-01	5.20E-06	9.21E-05	8.90E-05	8.20E-09
Benzene	Annual	50	3.54E-01	1.30E-04	2.30E-03	8.30E-06	1.91E-08
Benzo(a)pyrene	Annual	50	3.54E-01	8.20E-07	1.45E-05	1.70E-03	2.47E-08
N-Nitrosodiethylamine	Annual	50	3.54E-01	1.20E-07	2.13E-06	4.30E-02	9.14E-08
N-Nitrosodiphenylamine	Annual	50	3.54E-01	4.15E-07	7.35E-06	1.4E-06	1.03E-11
Styrene	Annual	50	3.54E-01	4.28E-04	7.58E-03	5.70E-07	4.32E-09
Chromium	Annual	50	3.54E-01	4.00E-06	7.08E-05	1.20E-02	8.50E-07
Nickel	Annual	50	3.54E-01	8.00E-04	1.42E-02	2.40E-04	3.40E-06
North 18 Boundary Receptor							
1,3-Butadiene	Annual	50	5.12E-01	6.56E-06	1.68E-04	2.80E-04	4.70E-08
2,4-Dinitrotoluene	Annual	50	5.12E-01	5.20E-06	1.33E-04	8.90E-05	1.18E-08
Benzene	Annual	50	5.12E-01	1.30E-04	3.33E-03	8.30E-06	2.76E-08
Benzo(a)pyrene	Annual	50	5.12E-01	8.20E-07	2.10E-05	1.70E-03	3.57E-08
N-Nitrosodiethylamine	Annual	50	5.12E-01	1.20E-07	3.07E-06	4.30E-02	1.32E-07
N-Nitrosodiphenylamine	Annual	50	5.12E-01	4.15E-07	1.06E-05	1.4E-06	1.49E-11
Styrene	Annual	50	5.12E-01	4.28E-04	1.10E-02	5.70E-07	6.24E-09
Chromium	Annual	50	5.12E-01	4.00E-06	1.02E-04	1.20E-02	1.23E-06
Nickel	Annual	50	5.12E-01	8.00E-04	2.05E-02	2.40E-04	4.91E-06

1 Air Concentrations = (treatment quantity) x (ADF per averaging period) x (Emission Factor)
2 Unit Risk Factor (URF) obtained from NJDEP Technical Manual 1003
3 Calculated Cancer Risk = Air Concentration ($\mu g/m^3$) x URF $(\mu g/m^3)^{-1}$

TABLE E-2-21

CALCULATED HAZARD QUOTIENT FOR THE AIR PATHWAY FROM OPEN DETONATION TREATMENT FOR THE MAXIMUM SENSITIVE AND BOUNDARY RECEPTOR LOCATIONS NAVAL WEAPONS STATION EARLE

Chemical	Averaging Period	Treatment Quantity (per event) (lbs NEW)	Averaging Period ADF ($\mu g/m^3$-lb)	Emission Factor (lb emitted per lb treated)	Air Concentration[1] ($\mu g/m^3$)	RfC[2] ($\mu g/m^3$)	Hazard Quotient[3]
Closest Offsite Sensitive Receptor							
1,4-Dichlorobenzene	Annual	50	3.54E-01	2.60E-07	4.61E-06	8.00E+02	5.76E-09
Acetophenone	Annual	50	3.54E-01	1.54E-07	2.73E-06	2.00E-02	1.36E-04
Ammonia	Annual	50	3.54E-01	2.92E-04	5.17E-03	1.00E+02	5.17E-05
Benzene	24-Hour	50	1.81E+00	2.39E-04	2.16E-02	1.90E+01	1.14E-03
Ethylbenzene	24-Hour	50	1.81E+00	2.38E-05	2.15E-03	1.00E+03	2.15E-06
Hexane	Annual	50	3.54E-01	8.04E-06	1.42E-04	2.00E+02	7.12E-07
Phenol	Annual	50	3.54E-01	2.30E-06	4.07E-05	4.50E+01	9.05E-07
Styrene	Annual	50	3.54E-01	4.28E-04	7.58E-03	1.00E+03	7.58E-06
Toluene	Annual	50	3.54E-01	6.67E-05	1.18E-03	4.00E+02	2.95E-06
Xylenes	24-Hour	50	1.81E+00	1.34E-04	1.21E-02	1.65E+02	7.34E-05
Barium	Annual	50	3.54E-01	1.74E-03	3.08E-02	5.00E-01	6.16E-02
Boron	Annual	50	3.54E-01	1.13E-02	2.00E-01	2.00E+01	1.00E-02
Chromium	Annual	50	3.54E-01	4.00E-06	7.08E-05	2.00E-03	3.54E-02
Lead	24-Hour	50	1.81E+00	7.10E-05	6.42E-03	1.00E-01	6.43E-02
Zinc	Annual	50	3.54E-01	7.10E-05	1.26E-03	2.00E-01	6.29E-03
North 18 Boundary Receptor							
1,4-Dichlorobenzene	Annual	50	5.12E-01	2.60E-07	6.66E-06	8.00E+02	8.32E-09
Acetophenone	Annual	50	5.12E-01	1.54E-07	3.94E-06	2.00E-02	1.97E-04
Ammonia	Annual	50	5.12E-01	2.92E-04	7.47E-03	1.00E+02	7.47E-05
Benzene	24-Hour	50	2.61E+00	2.39E-04	3.12E-02	1.90E+01	1.64E-03
Ethylbenzene	24-Hour	50	2.61E+00	2.38E-05	3.11E-03	1.00E+03	3.11E-06
Hexane	Annual	50	5.12E-01	8.04E-06	2.06E-04	2.00E+02	1.03E-06
Phenol	Annual	50	5.12E-01	2.30E-06	5.89E-05	4.50E+01	1.31E-06
Styrene	Annual	50	5.12E-01	4.28E-04	1.10E-02	1.00E+03	1.10E-05
Toluene	Annual	50	5.12E-01	6.67E-05	1.71E-03	6.80E+01	2.51E-05
Xylenes	24-Hour	50	2.61E+00	1.34E-04	1.75E-02	1.65E+02	1.06E-04
Barium	Annual	50	5.12E-01	1.74E-03	4.45E-02	5.00E-01	8.91E-02
Boron	Annual	50	5.12E-01	1.13E-02	2.89E-01	2.00E+01	1.45E-02
Chromium	Annual	50	5.12E-01	4.00E-06	1.02E-04	2.00E-03	5.12E-02
Lead	24-Hour	50	2.61E+00	7.10E-05	9.28E-03	1.30E-01	7.14E-02
Zinc	Annual	50	5.12E-01	7.10E-05	1.82E-03	2.00E-01	9.09E-03

1 Air Concentrations = (treatment quantity) x (ADF averaging period) x (Emission Factors)
2 Reference Concentration (RfC) obtained from NJDEP Technical Manual 1003
3 Hazard Quotient = Air Concentration ($\mu g/m^3$)/RfC ($\mu g/m^3$)

TABLE E-2-22

A COMPARISON OF CRITERIA POLLUTANT AIR QUALITY STANDARDS TO IMPACTS FROM OPEN DETONATION TREATMENT FOR THE MAXIMUM SENSITIVE AND BOUNDARY RECEPTOR LOCATIONS NAVAL WEAPONS STATION EARLE

Chemical	Averaging Period	Treatment Quantity per event (lbs NEW)	Emission Factors (lbs/lbs)	Averaging Period ADF ($\mu g/m^3$-lb)	OD Maximum Concentration ($\mu g/m^3$)	Ambient Background Concentration ($\mu g/m^3$)	Total Impact ($\mu g/m^3$)	NJAAQS/NAAQS ($\mu g/m^3$)
Closest Offsite Sensitive Receptor								
Carbon Monoxide	1-hour	50	5.15E-02	1.55E+01	3.99E+01	12,315	12,355	40,000
Carbon Monoxide	8-hour	50	5.15E-02	9.49E+00	2.44E+01	7,436	7,460	10,000
Lead	Quarterly	50	7.10E-05	3.54E-01	1.26E-03	0.05	0.05	1.5
Nitrogen Dioxide	Annual	50	1.34E-03	3.54E-01	2.37E-02	46	46	100
PM10	24-Hour	50	4.00E-01	1.81E+00	3.62E+01	51	87	150
PM10	Annual	50	2.40E-01	3.54E-01	4.25E+00	23	28	50
Sulfur Dioxide	3-hour	50	2.23E-04	1.55E+01	1.73E-01	112	112	1,300
Sulfur Dioxide	24-hour	50	2.23E-04	1.81E+00	2.02E-02	80	80	365
Sulfur Dioxide	Annual	50	2.23E-04	3.54E-01	3.95E-03	13	13	80
TSP	24-hour	50	4.00E-01	1.81E+00	3.62E+01	75	111	150
TSP	Annual	50	2.40E-01	3.54E-01	4.25E+00	22	26	75(P)
TSP	Annual	50	2.40E-01	3.54E-01	4.25E+00	22	26	60(S)
North 18 Boundary Receptor								
Carbon Monoxide	1-hour	50	5.15E-02	2.24E+01	5.77E+01	12,315	12,373	40,000
Carbon Monoxide	8-hour	50	5.15E-02	1.37E+01	3.53E+01	7,436	7,471	10,000
Lead	Quarterly	50	7.10E-05	5.12E-01	1.82E-03	0.05	0.05	1.5
Nitrogen Dioxide	Annual	50	1.34E-03	5.12E-01	3.43E-02	46	46	100
PM10	24-Hour	50	4.00E-01	2.61E+00	5.23E+01	51	103	150
PM10	Annual	50	2.40E-01	5.12E-01	6.14E+00	23	29	50
Sulfur Dioxide	3-hour	50	2.23E-04	2.24E+01	2.50E-01	112	112	1,300
Sulfur Dioxide	24-hour	50	2.23E-04	2.61E+00	2.91E-02	80	80	365
Sulfur Dioxide	Annual	50	2.23E-04	5.12E-01	5.71E-03	13	13	80
TSP	24-hour	50	4.00E-01	2.61E+00	5.23E+01	75	127	150
TSP	Annual	50	2.40E-01	5.12E-01	6.14E+00	22	28	75(P)
TSP	Annual	50	2.40E-01	5.12E-01	6.14E+00	22	28	60(S)

Open Detonation Maximum Concentration = (Emission Factor) x (Treatment Quantity per event) x (Averaging Period ADF)
Total Impact = Ambient Background Concentration + OD Maximum Concentration
(P) - New Jersey Primary Standard
(S) - New Jersey Secondary Standard
NJAAQS - New Jersey Ambient Air Quality Standards
NAAQS - National Ambient Air Quality Standards

TABLE E-2-23

CALCULATED CANCER RISK FOR THE AIR PATHWAY FROM WIND EROSION TREATMENT FOR THE MAXIMUM SENSITIVE AND BOUNDARY RECEPTOR LOCATIONS NAVAL WEAPONS STATION EARLE

Chemical	Averaging Period	Emission Rate (g/m^2-sec)	Annual ADF ($\mu g/m^3$-g/m^2-sec)	Maximum Air[1] Concentration ($\mu g/m^3$)	URF[2] $(\mu g/m^3)^{-1}$	Calculated Cancer Risk[3]
Closest Offsite Sensitive Receptor						
2,4 Dinitrotoluene	Annual	3.43E-08	3.36E+00	1.15E-07	8.90E-05	1.02E-11
Arsenic	Annual	3.25E-06	3.36E+00	1.09E-05	4.30E-03	4.69E-08
Beryllium	Annual	4.95E-07	3.36E+00	1.66E-06	2.40E-03	3.98E-09
Cadmium	Annual	6.65E-07	3.36E+00	2.23E-06	3.50E-03	7.81E-09
Nickel	Annual	2.20E-06	3.36E+00	7.38E-06	2.40E-04	1.77E-09
Selenium	Annual	3.43E-07	3.36E+00	1.15E-06	1.40E-04	1.61E-10
North 18 Boundary Receptor						
2,4 Dinitrotoluene	Annual	3.42E-08	5.52E+00	1.89E-07	8.90E-05	1.68E-11
Arsenic	Annual	3.26E-06	5.52E+00	1.80E-05	4.30E-03	7.74E-08
Beryllium	Annual	4.94E-07	5.52E+00	2.73E-06	2.40E-03	6.55E-09
Cadmium	Annual	6.65E-07	5.52E+00	3.67E-06	3.50E-03	1.28E-08
Nickel	Annual	2.21E-06	5.52E+00	1.22E-05	2.40E-04	2.93E-09
Selenium	Annual	3.42E-07	5.52E+00	1.89E-06	1.40E-04	2.65E-10

Emission rates were back-calculated by dividing the air concentration (obtained from FDM modeling and 95 UCL soil concentrations) by the annual ADF.

1 Air Concentration ($\mu g/m^3$) = Emissions (g/m^2-sec) x ADF ($\mu g/m^3$-g/m^2-sec)
2 Unit Risk Factor (URF) obtained from NJDEP Technical Manual 1003
3 Calculated Cancer Risk = Air Concentration ($\mu g/m^3$) x URF $(\mu g/m^3)^{-1}$

TABLE E-2-24

CALCULATED HAZARD QUOTIENT FOR THE AIR PATHWAY FROM WIND EROSION TREATMENT FOR THE MAXIMUM SENSITIVE AND BOUNDARY RECEPTOR LOCATIONS
NAVAL WEAPONS STATION EARLE

Chemical	Averaging Period	Emission Rate (g/m^2-sec)	Annual ADF ($\mu g/m^3$-g/m^2-sec)	Air Concentration[1] ($\mu g/m^3$)	RfC[2] ($\mu g/m^3$)	Hazard Quotient[3]
Closest Offsite Sensitive Receptor						
Barium	Annual	7.03E-06	3.36E+00	2.36E-05	5.00E-01	4.72E-05
Copper	Annual	5.81E-06	3.36E+00	1.95E-05	1.30E-01	1.50E-04
Lead	24 Hour	2.56E-05	1.22E+00	3.12E-04	1.00E-01	3.12E-03
Mercury	Annual	1.08E-07	3.36E+00	3.61E-07	3.00E-01	1.20E-06
Selenium	Annual	3.43E-07	3.36E+00	1.15E-06	5.00E-01	2.30E-06
Zinc	Annual	1.22E-05	3.36E+00	4.08E-05	2.00E-01	2.04E-04
North 18 Boundary Receptor						
Barium	Annual	7.04E-06	5.52E+00	3.89E-05	5.00E-01	7.78E-05
Copper	Annual	5.81E-06	5.52E+00	3.21E-05	1.30E-01	2.47E-04
Lead	24 Hour	2.56E-05	2.01E+00	5.14E-04	1.00E-01	5.14E-03
Mercury	Annual	1.08E-07	5.52E+00	5.95E-07	3.00E-01	1.98E-06
Selenium	Annual	3.42E-07	5.52E+00	1.89E-06	5.00E-01	3.78E-06
Zinc	Annual	1.22E-05	5.52E+00	6.72E-05	2.00E-01	3.36E-04

1 Air Concentration ($\mu g/m^3$) = Emissions per Averaging Period (g/m^2-sec/averaging period) x Averaging Period ADF ($\mu g/m^3$-g/m^2-sec)
2 Reference concentration (RfC) obtained from NJDEP Technical Manual 1003
3 Hazard Quotient = Air Concentration ($\mu g/m^3$)/RfC ($\mu g/m^3$)

TABLE E-2-25

A COMPARISON OF CRITERIA POLLUTANT AIR QUALITY STANDARDS TO IMPACTS FROM EOD SITE WIND EROSION FOR THE MAXIMUM SENSITIVE AND BOUNDARY RECEPTOR LOCATIONS NAVAL WEAPONS STATION EARLE

Chemical	Averaging Period	Emission Factors (lbs/lbs)	Averaging Period ADF ($\mu g/m^3$-lb)	Maximum Air Concentration ($\mu g/m^3$)	Ambient Background Concentration ($\mu g/m^3$)	Total Impact ($\mu g/m^3$)	NJAAQS/NAAQS ($\mu g/m^3$)
Closest Offsite Sensitive Receptor							
Lead	Quarterly	7.42E-05	3.36E+00	2.49E-04	0.053	0.05	1.5
TSP	24-hour	1.00E+00	1.22E+01	1.22E+01	75	87.20	150
TSP	Annual	7.27E-01	3.36E+00	2.44E+00	22	24.44	75(P)
TSP	Annual	7.27E-01	3.36E+00	2.44E+00	22	24.44	60(S)
North 18 Boundary Receptor							
Lead	Quarterly	4.51E-05	5.52E+00	2.49E-04	0.053	0.05	1.5
TSP	24-hour	6.08E-01	2.01E+01	1.22E+01	75	87.20	150
TSP	Annual	4.42E-01	5.52E+00	2.44E+00	22	24.44	75(P)
TSP	Annual	4.42E-01	5.52E+00	2.44E+00	22	24.44	60(S)

Emission rates were back-calculated by dividing the air concentration (obtained from FDM modeling and 95 UCL soil concentrations) by the annual ADF.
Wind Erosion Emission Factor = Maximum Concentration / Averaging Period ADF
Total Impact = Ambient Background Concentration + Maximum Air Concentration
(P) - New Jersey Primary Standard
(S) - New Jersey Secondary Standard
NJAAQS - New Jersey Ambient Air Quality Standards
NAAQS - National Ambient Air Quality Standards

risk. Table E-2-24 presents the hazard quotients, whereas Table E-2-25 shows a comparison of ambient impacts to applicable air quality standards for criteria pollutants. Appendix E-2-5 contains information on the determination of particle size, emission rates, matrix of stability classes and wind speeds, receptors, derivation of the 95 percent UCL for soil constituents, the soils data and the calculation of ground-level-concentrations.

E-2-5c Cumulative Impact From All Sources

E-2-5c(1) Cumulative Risk

The total worst case cumulative risk from all treatment units and the wind erosion scenario for each contaminant having a unit risk factor (URF) is shown in Table E-2-26.

E-2-5c(2) Cumulative Hazard

The total worst case cumulative hazard quotient from all treatment units and the wind erosion scenario for all contaminants having a reference concentration (RfC) is shown in Table E-2-27.

E-2-5c(3) Cumulative Ambient Concentration

The total worst case ambient impact from all NWS Earle treatment units, the wind erosion scenario and background sources for averaging periods associated with New Jersey and National air quality standards are summarized in Table E-2-28.

E-2-6 UNCERTAINTY ANALYSIS

E-2-6a Emission Factors/Emission Rates

Uncertainty in emissions data exists in the identification of constituents from each treatment source and the quantification of emissions. Emissions from the propellant pan, small arms pan, and open detonation treatment units come from the emissions of unreacted waste constituents, products of combustion (POCs), and products of incomplete combustion (PICs). Treatment unit emission factors were used in conjunction with treatment quantity information and ADFs to calculate ambient concentrations. In the case of wind erosion, soil sampling data were used in conjunction with ADFs to calculate ambient concentrations.

Open Burning Emissions Uncertainty

Information on waste constituent chemical composition was available for waste materials which are representative of all waste materials treated at NWS Earle. Therefore, the degree of uncertainty in regard to identification of waste constituents is low. It was assumed that organic waste constituents would be emitted at a Destruction/Removal Efficiency (DRE) of 99.99 percent and that all metals present in the OB waste feed would be emitted (metals in, metals out). Data from the AMCCOM Bang Box tests indicate that the actual DRE for OB is greater than 99.999 percent. Therefore, the level of uncertainty associated with emission factors for untreated organic waste constituents could be as much as one order of magnitude of overestimation of untreated organic waste constituents. The level of uncertainty associated with emission factors for metal emissions from the energetic materials is considered low, since the identity and concentrations of metallic constituents are known and it is assumed that all metallics are emitted. Nevertheless, "worst case" maximum assumptions were made with regard to metals present.

Information on the POCs and PICs was obtained from AMCCOM test data. The materials tested and the emission constituents tested were chosen to be fully representative of OB emissions. The tests were conducted on a relatively limited set of materials when compared to those treated at NWS Earle. However, the elemental composition of the materials is very similar to those treated at NWS Earle. Based on combustion theory, the POCs and PICs should be similar.

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TABLE E-2-26

CUMULATIVE WORST-CASE CANCER RISKS FOR OB/OD TREATMENT UNITS AND WIND EROSION SCENARIO NAVAL WEAPONS STATION EARLE

Chemical	Averaging Period	Risk from Propellant Pans per Averaging Period	Risk from Small Arms Pans per Averaging Period	Risk from Open Detonation per Averaging Period	Risk from Wind Erosion per Averaging Period	Cumulative Annual Cancer Risks
Closest Offsite Sensitive Receptor						
1,3-Butadiene	Annual			3.25E-08		3.25E-08
2,4-Dinitrotoluene	Annual	9.28E-10	6.69E-10	8.20E-09	1.02E-11	9.81E-09
Arsenic	Annual				4.69E-08	4.69E-08
Beryllium	Annual				3.98E-09	3.98E-09
Benzene	Annual	1.52E-10	1.09E-10	1.91E-08		1.94E-08
Benzo(a)pyrene	Annual	8.31E-10	5.99E-10	2.47E-08		2.61E-08
Cadmium	Annual				7.81E-09	7.81E-09
Chromium	Annual			8.50E-07		8.50E-07
Nickel	Annual			3.40E-06	1.77E-09	3.40E-06
N-Nitrosodiethylamine	Annual			9.14E-08		9.14E-08
N-Nitrosodiphenylamine	Annual	1.05E-12	7.57E-13	4.19E-12		6.00E-12
Selenium	Annual				1.61E-10	1.61E-10
Styrene	Annual			4.32E-09		4.32E-09
North 18 Boundary Receptor						
1,3-Butadiene	Annual			4.70E-08		4.70E-08
2,4-Dinitrotoluene	Annual	8.68E-10	9.74E-10	1.18E-08	1.68E-11	1.37E-08
Arsenic	Annual				7.74E-08	7.74E-08
Beryllium	Annual				6.55E-09	6.55E-09
Benzene	Annual	1.42E-10	1.59E-10	2.76E-08		2.79E-08
Benzo(a)pyrene	Annual	7.77E-10	8.72E-10	3.57E-08		3.73E-08
Cadmium	Annual				1.28E-08	1.28E-08
Chromium	Annual			1.23E-06		1.23E-06
Nickel	Annual			4.91E-06	2.93E-09	4.92E-06
N-Nitrosodiethylamine	Annual			1.32E-07		1.32E-07
N-Nitrosodiphenylamine	Annual	9.81E-13	1.10E-12	6.05E-12		8.14E-12
Selenium	Annual				2.65E-10	2.65E-10
Styrene	Annual			6.24E-09		6.24E-09

TABLE E-2-27

CUMULATIVE WORST-CASE HAZARD QUOTIENT FOR OB/OD TREATMENT UNITS AND WIND EROSION SCENARIO NAVAL WEAPONS STATION EARLE

Chemical	Averaging Period	Hazard Quotient from Propellant Pans per Averaging Period	Hazard Quotient from Small Arm Pans per Averaging Period	Hazard Quotient from Open Detonations per Averaging Period	Hazard Quotient from Wind Erosion per Averaging Period	Cumulative Hazard Quotient	
						Annual	24 Hour
Closest Offsite Sensitive Receptor							
1,4-Dichlorobenzene	Annual			5.76E-09		5.76E-09	
Acetophenone	Annual			1.36E-04		1.36E-04	
Ammonia	Annual	6.52E-07	4.70E-07	5.17E-05		5.28E-05	
Benzene	24-Hour	5.74E-04	1.66E-04	1.14E-03			1.88E-03
Barium	Annual	1.00E-02	5.27E-04	6.16E-02	7.78E-05	7.23E-02	
Boron	Annual			1.00E-02		1.00E-02	
Chromium	Annual			3.54E-02		3.54E-02	
Copper	Annual	1.39E-03			1.50E-04	1.54E-03	
Ethylbenzene	24-Hour			2.15E-06			2.15E-06
Hexane	Annual			7.12E-07		7.12E-07	
Lead	24-Hour	1.00E+01	6.89E+00	4.94E-02	3.12E-03		1.69E+01
Mercury	Annual				1.20E-06	1.20E-06	
Phenol	Annual	1.67E-07	1.20E-07	9.05E-07		1.19E-06	
Selenium	Annual				2.30E-06	2.30E-06	
Styrene	Annual			7.58E-06		7.58E-06	
Toluene	Annual			1.74E-05		1.74E-05	
Xylenes	24-Hour			7.34E-05			7.34E-05
Zinc	Annual	8.15E-05	9.05E-04	6.29E-03	2.04E-04	7.48E-03	
North 18 Boundary Receptor							
1,4-Dichlorobenzene	Annual			8.32E-09		8.32E-09	
Acetophenone	Annual			1.97E-04		1.97E-04	
Ammonia	Annual	6.09E-07	6.84E-07	7.47E-05		7.60E-05	
Benzene	24-Hour	5.37E-04	2.41E-04	1.64E-03			2.42E-03
Barium	Annual	9.39E-03	7.66E-04	8.91E-02	7.78E-05	9.93E-02	
Boron	Annual			1.45E-02		1.45E-02	
Chromium	Annual			5.12E-02		5.12E-02	
Copper	Annual	1.30E-03			2.47E-04	1.54E-03	
Ethylbenzene	24-Hour			3.11E-06			3.11E-06
Hexane	Annual			1.03E-06		1.03E-06	
Lead	24-Hour	9.37E+00	1.00E+01	7.14E-02	5.14E-03		1.95E+01
Mercury	Annual				1.98E-06	1.98E-06	
Phenol	Annual	1.56E-07	1.75E-07	1.31E-06		1.64E-06	
Selenium	Annual				3.78E-06	3.78E-06	
Styrene	Annual			1.10E-05		1.10E-05	
Toluene	Annual			2.51E-05		2.51E-05	
Xylenes	24-Hour			1.06E-04			1.06E-04
Zinc	Annual	7.62E-05	1.32E-03	9.09E-03	3.36E-04	1.08E-02	

a If either the propellant pans or the small arms pan treat the maximum quantity of lead (7.1 and 1.06 pounds respectively) in a 24-hour peirod, the other tretment unit is not permitted to treat lead containing items in the same 24-hour period.

TABLE E-2-28

CUMULATIVE WORST-CASE AMBIENT IMPACT FROM TREATMENT UNITS AND WIND EROSION SCENARIO AND BACKGROUND SOURCES IN COMPARISON TO NJAAQS AND NAAQS NAVAL WEAPONS STATION EARLE

Chemical	Averaging Period	Maximum Concentrations from Propellant Pans per Averaging Period (µg/m³)	Maximum Concentrations from Small Arms Pans per Averaging Period (µg/m³)	Maximum Concentrations from Open Detonation per Averaging Period (µg/m³)	Maximum Concentrations for Wind Erosion per Averaging Period (µg/m³)	Background Concentrations (µg/m³)	Cumulative Air Concentrations (µg/m³)						NJAAQS/ NAAQS (µg/m³)
							1 hour	3 hour	8 hour	24 hour	Quarterly	Annual	
Closest Offsite Sensitive Receptor													
Carbon Monoxide	1-hour	8.30E-01	4.79E-01	3.99E+01		12,315	12,356						40,000
Carbon Monoxide	8-hour	1.45E-01	4.19E-02	2.44E+01		7,436			7,460				10,000
Lead	Quarterly	2.89E-02	5.00E-02	1.26E-03	2.49E-04	0.05					0.13		1.5
Nitrogen Dioxide	Annual	2.44E-03	1.76E-03	2.37E-02		46						46	100
PM10	24-Hour	1.80E+00	5.20E-01	3.62E+01		51				89			150
PM10	Annual	3.59E-02	2.59E-02	4.25E+00		23						28	50
Sulfur Dioxide	3-hour	6.62E-01	1.91E-01	1.73E-01		112		113					1,300
Sulfur Dioxide	24-hour	8.27E-02	2.39E-02	2.02E-02		80				80			365
Sulfur Dioxide	Annual	7.21E-01	5.88E-04	3.95E-03		13						14	80
TSP	24-hour	1.80E+00	5.20E-01	3.62E+01	1.22E+01	75				126			150
TSP	Annual	3.59E-02	2.59E-02	4.25E+00	2.44E+00	22						29	75
TSP	Annual	3.59E-02	2.59E-02	4.25E+00	2.44E+00	22						29	60
North 18 Boundary Receptor													
Carbon Monoxide	1-hour	7.76E-01	6.97E-01	5.77E+01		12,315	12,374						40,000
Carbon Monoxide	8-hour	1.36E-01	6.10E-02	3.53E+01		7,436			7,471				10,000
Lead	Quarterly	2.71E-02	7.25E-02	1.82E-03	2.49E-04	0.05					0.15		1.5
Nitrogen Dioxide	Annual	2.29E-03	2.57E-03	3.43E-02		46						46	100
PM10	24-Hour	1.69E+00	7.57E-01	5.23E+01		51				106			150
PM10	Annual	3.35E-02	3.76E-02	6.14E+00		23						30	50
Sulfur Dioxide	3-hour	6.19E-01	2.78E-01	2.50E-01		112		113					1,300
Sulfur Dioxide	24-hour	7.73E-02	3.47E-02	2.91E-02		80				80			365
Sulfur Dioxide	Annual	7.62E-04	8.55E-04	5.71E-03		13						13	80
TSP	24-hour	1.69E+00	7.57E-01	5.23E+01	1.22E+01	75				142			150
TSP	Annual	3.35E-02	3.76E-02	6.14E+00	2.44E+00	22						31	75
TSP	Annual	3.35E-02	3.76E-02	6.14E+00	2.44E+00	22						31	60

The OB emission rates for the various averaging periods evaluated in the air pathway assessment and risk assessment are based on NWS Earle SOP maximum allowable treatment quantities.

Open Detonation Emissions Uncertainty

Information on the chemical composition of waste constituent was available for the energetic portion of each of the waste materials that are representative of all waste materials treated at NWS Earle. Therefore, the degree of uncertainty with regard to identification of OD feed energetic waste constituents is considered low. It was assumed that OD energetic organic waste constituents would be emitted at a DRE of 99.99 percent and that all energetics present in the OD waste feed would be emitted (metals in, metals out). Data from the AMCCOM Bang Box tests indicate that the actual DRE for OB is greater than 99.999 percent. Therefore, the level of uncertainty associated with OD emission factors for organic waste constituents could be as much as one order of magnitude of overestimation of untreated organic waste constituents. The level of uncertainty associated with energetic metal emission factors is considered low, since the identity and concentrations of energetic metallic constituents are known and it is assumed that all energetic metallics are emitted. Nevertheless, "worst case" maximum assumptions were made with regard to the quantities of metals present.

Information on the POCs and PICs for OD was obtained from AMCCOM/USAFACC test data. The materials tested and the emission constituents tested were chosen to be fully representative of OD emissions. The elemental composition of the materials is very similar to those treated at NWS Earle. Based on combustion theory, the POCs and PICs should be similar.

The OD emission rates for the various averaging periods evaluated in the air pathway assessment and risk assessment are based on NWS Earle SOP maximum allowable treatment quantities.

E-2-6b **Modeling Assumptions**

The air dispersion modeling analysis conducted for the air pathway assessment included a number of assumptions that are expected to result in a conservatively high, worst-case estimate of air dispersion factors and ambient concentrations. For example, the modeling protocol for each emission source modeling demonstration assumed that the plume always traveled in a straight line from the release point to the downwind receptor. This invariant wind direction methodology is designed to conservatively calculate the maximum air dispersion factor by maintaining the target receptor along the plume centerline. The assumption is conservative in that it transports the plume from the source to the receptor in the shortest time and distance, and thus results in minimal dispersion and the calculation of worst-case air dispersion factors.

In addition, conservatively low estimates for treatment plume exit velocity and temperature are expected to result in low final plume heights and higher air dispersion factors and ground level concentrations. The values assumed for these source parameters are considered to be conservatively low based on the very nature of the OB and OD combustion process. Information obtained from plume height studies for the small arms pan and open detonation were used to estimate exit temperature in dispersion modeling sensitivity studies. In all cases, the lowest observed plume heights were used to estimate source parameters.

E-2-6c **Dispersion Models/Modeling Assumptions**

The modeling demonstrations conducted for the propellant pan, small arms pan, open detonation, and the wind erosion scenario each required a specific air-quality dispersion model to correctly simulate the emission release associated with each source. The models chosen are approved by U.S. EPA for regulatory modeling demonstrations and are presumed to be capable of simulating the source being evaluated in the air pathway assessment.

Because the propellant pan, small arms pan, and open detonation treatment units are associated with emission periods ranging from seconds to several minutes, a puff release dispersion model was assumed to be most appropriate for these sources. The INPUFF model was chosen to simulate treatment operations because it simulates release and dispersion from instantaneous and semi-instantaneous (puff) sources.

In the case of the wind erosion scenario, it was assumed that this source was a fugitive emission source and could be modeled using the Fugitive Dust Model (FDM). FDM is specifically designed for computing concentration impacts from fugitive dust sources, such as wind erosion, and is presumed capable of simulating wind erosion at the EOD site.

E-2-6d **Calculation Procedures**

Both the INPUFF and FDM models are assumed to be appropriate for modeling the emission sources being evaluated in the air pathway assessment. The models, in combination with other conservative modeling assumptions and source parameters used in the air pathway assessment, are expected to overpredict receptor concentrations.

Further conservatism was incorporated into the calculation of air dispersion factors for averaging periods beyond 1-hour for each treatment unit and the wind erosion scenario. The U.S. EPA screening guidance factors for extrapolating 1-hour concentrations to longer averaging periods include a degree of conservatism to provide reasonable assurance that maximum concentrations will not be underestimated. Using these factors is expected to result in the overprediction of air dispersion factors (ADFs).

Worst-case one hour ADF's for each of the treatment units discussed were determined under different meteorological conditions (i.e. different wind speeds and stability classes). To maintain a conservatism approach, the worst-case one hour ADF's (as well as the 3-hour, 8-hour, 24-hour, quarterly, and annual averaging period ADF's) were used to determine a worst-case ambient concentration despite the varying meteorology. The concentrations from these various treatment units and averaging periods were than summed to provide a cumulative concentration from treatment units operating concurrently.